ELECTRONICS Australia

HIFI NEWS

MARCH 1974
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CLOSED CIRCUIT TELEVISION FOR SCHOOLS AND COLLEGES

HOW GOOD ARE THESE NEW OMNIDIRECTIONAL HI-FI LOUDSPEAKERS?

ARMCHAIR SPACE ODYSSEY TO JUPITER AND RETURN

BUILD OUR NEW BUZZ BAR: ELECTRONIC GAME OF SKILL

DECODER FOR 4-CHANNEL SQ RECORDS USES SPECIAL IC

NEW MINIATURE LOGIC LAB

SONY SOUND SEDUCES SCIENTIST...

The man in the white coat is a sound specialist. And he has just been captured by Sony. He's puzzling how such quality sound can come from such a compact, low-priced system. It's Sony's newest combination — the feature-packed Sony integrated amplifier model TA-1066. It has direct coupled differential power amplifier, a balanced positive and negative power supplied equalizer amplifier, and true complimentary circuits. Styling is the latest, with push button controls. Inputs and outputs for 2 tape decks permit dubbing between the deck and simultaneous recording. Slide volume balance has centre click adjustment. Frequency response is 10 Hz-40kHz and it cruises at 15W RMS per channel.

It teams with the new Sony TC-129 cassette tape deck with long-lasting Ferrite & Ferrite heads and capacity to play C_2O_2 tapes as well as standard. Auto stop, naturally. And a handy hinged dust cover lid. Frequency response with ordinary tapes 40Hz-12kHz and with C_2O_2 40Hz-14kHz.

Speakers are 2 Sony SS-7100's — the latest Ultra Linear System from Sony for great sound right across the spectrum. Combines 8″ woofer with 1″ dome type tweeter.

Together they make beautiful music that will charm you — just as it did the man in the white coat.

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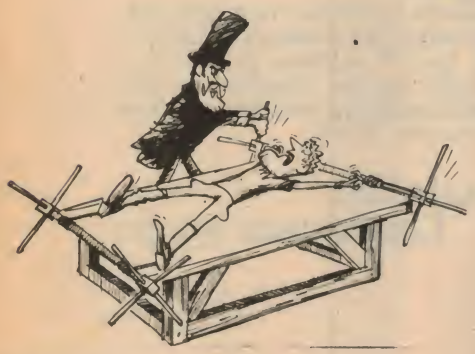
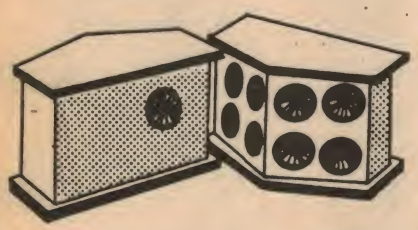
ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 35 No 12



YOU'VE CONVINCED US, Arthur Cushen's shortwave notes are obviously read and very much appreciated by many readers! The column starts again this month on page 109, with the new heading "Shortwave Scene." Just don't send any more of those irate cards and letters . . .



There's an interesting story behind the new omnidirectional loudspeaker systema,' as Neville Williams explains in the story starting on page 11.

On the cover

Closed-circuit and cable TV are becoming widely used for education. Our cover picture shows the school TV studio of the city of Frankfurt, Germany, which provides programs for the city's schools. More details are given on page 35. (Picture courtesy Philips Industries Ltd.)

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world of electronics and hi-fi

projects and technical

regular features

The goal of every audio enthusiast...

(that elusive sense of actually being there)

True concert hall reproduction is unobtainable through the conventional speaker system for one very basic reason. The conventional system projects nearly all of its sound directly at the listener. Yet, in the concert hall the majority of sound, nearly 90% is reflected or indirect. So, even if your system will reproduce a sound exactly as played in the concert hall, your ear will not receive it in the same manner.

Unless of course, you have the Philips Quadreflect Loudspeaker System. The quadreflect is designed around this very principle of reflected sound. Comprised of three rear "Sound Planes" which project sound left, right and upwards, reflecting off adjacent walls and then combining with the right proportion of direct sound from a fourth "frontal" plane, the system completely envelopes the room with sound, giving a degree of realism unmatched by conventional systems.

The ultimate in concert hall reproduction, this system comprises no less than three 1" dome tweeters, four 7" woofers (per box), is capable of 80 watts rms per channel and can, under ideal conditions, give a flat response from as low as 32 Hz to over 20 kHz.

Philips Quadreflect
Loudspeaker System.

Rear view of Quadreflect with grille cloth assembly removed.

PHILIPS

You can hear the Quadreflect System demonstrated at Magnetic Sound, 387 George Street, Sydney,
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P.O. Box 50, Lane Cove, N.S.W. 2066.

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ELECTRONIC COMPONENTS AND MATERIALS

(The Quadreflect System is also available in kit form)

153.53

Editorial Viewpoint

"Ultra" or "very": that is the question . . .

One of the frustrations of publishing a monthly magazine is the difficulty of reporting or commenting upon day to day events. Depending on schedules, material may typically be three weeks old when it appears, and may have been rendered inappropriate by subsequent developments.

Seldom has this been better illustrated than by the current inquiry into FM broadcasting. When our February issue went to press, for release on January 28, it was much too early to say anything of consequence. What has happened since has been reported in the daily and weekly press — a pot pourri of the submissions and opinions to date. As we face the deadline for March, further sittings are scheduled and it is anybody's guess whether certain lines of thinking will be reinforced or undermined.

To this point, the submissions have been along fairly predictable lines, largely a repetition of what have been said many times before: Music and culture groups have come out strongly in favour of a conventional VHF FM system, minimising the alleged problems of clearing the needed frequencies; importers have supported them, pointing up the number of FM tuner / receivers that have entered the country in recent years; local manufacturing interests, by and large, still want a UHF system, accusations of self-interest notwithstanding; broadcasting interests are astride the fence, claiming only access to the new medium, whatever it is.

The real significance is not in what has been said, but in the way it has been heard. In our April and May issues, last year, we drew attention to the very early winds of change, and our "Forum" article entitled "VHF / FM is stirring in its grave" did the rounds in Canberra. From the Inquiry thus far, one gathers the impression that the VHF corpse is not just stirring; it is showing a surprising degree of virility!

In the short term, a decision in favour of VHF FM would be right up our alley as a hifi orientated magazine. What the Inquiry has to do is to re-evaluate self-interest, emotion and ambition against hard technical and financial fact. And this is where the real problem lies. One expert says that certain interference problems will arise; another says they won't; both are extrapolating from data which happens to suit their point of view. And so on!

We can only hope that, as the smoke clears, there will be one clear road ahead. Not still a multiplicity of tracks!

—Neville Williams

EDITOR-IN-CHIEF
Neville Williams
M.I.R.E.E. (Aust.) (VK2XV).

EDITOR
Jamieson Rowe
B.A. (Sydney), B.Sc. (Technology, NSW)
M.I.R.E.E. (Aust.) (VK2ZLO / T)

ASSISTANT EDITOR
Philip Watson
A.M.I.R.E.E. (Aust.) (VK2ZPW)

EDITORIAL STAFF
David Edwards, B.E. (Hons, Tasmania).
Ian Pogson (VK2AZN / T)
Leo Simpson
Greg Swain, B.Sc. (Hons, Sydney)
Ross Tester

GRAPHICS
Robert Flynn
Greg Barlow

ADVERTISING MANAGER
Selwyn Sayers

CIRCULATION MANAGER
Alan Parker

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Editorial Office
12th Floor, 235 — 243 Jones Street, Broadway, Sydney, 2007 Phone 2 0944.
Postal Address: PO Box 157, Beaconsfield 2014.

Advertising Offices
Sydney — 57-59 Regent St, Sydney 2008. Phone 699 3622.
Representative: Graham Gawne.
Melbourne — 374 Little Collins Street, Melbourne, 3000. Phone 67 7021.
Representative: Jeffrey Byrne.
Adelaide — Charles F. Brown & Associates Ltd, 429 Pulteney Street, Adelaide, 5000. Representative: Tom Duffy 23 1657.
Perth — 454 Murray Street, Perth, 6000. Representative: Jack Hansen. 21 8217.

Subscriptions
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E403

INSTROL

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E403

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Today Sansui equipment leads the field, at home in Japan and overseas. Sansui's formidable reputation has been built around the performance and reliability of the Sansui product. With Japan's most dedicated electronic engineers at the drawing boards *and* supervising production, it's not surprising.

Sansui

Sansui sets world wide standards for audio equipment. You're always ahead technically when you buy Sansui. And you get extraordinary value for money. *See your Bleakley Gray dealer!*

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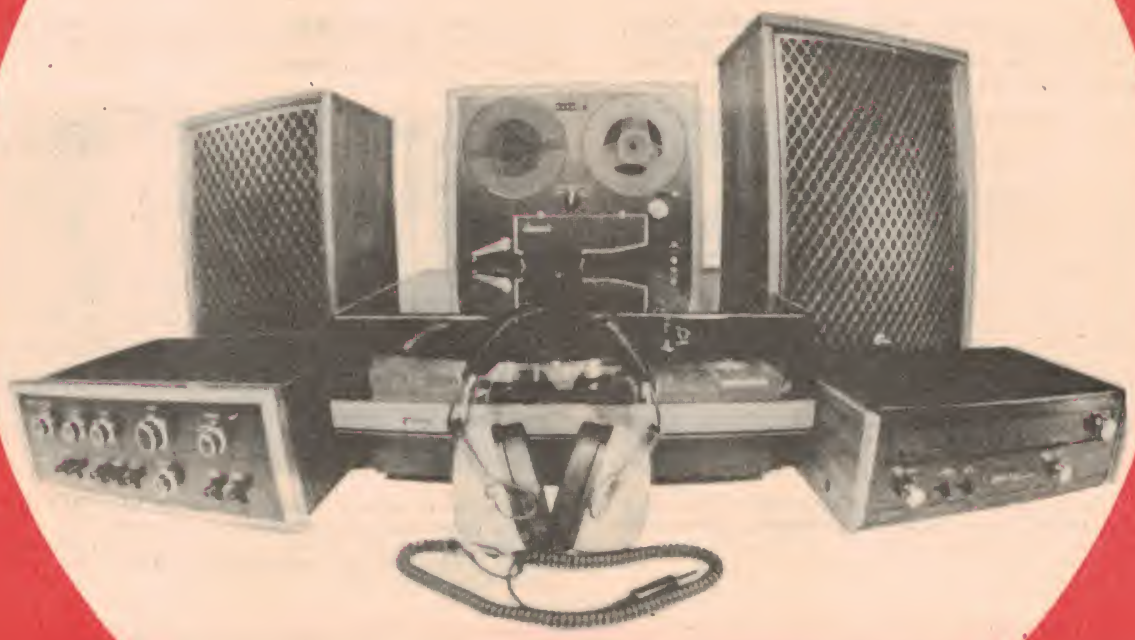

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Anyway our problem is not to sell S.A.E., but to get it. Our next two shipments are just about sold out, so what's the point in advertising? It'll only make the supply position worse."

That's why we decided not to advertise S.A.E.

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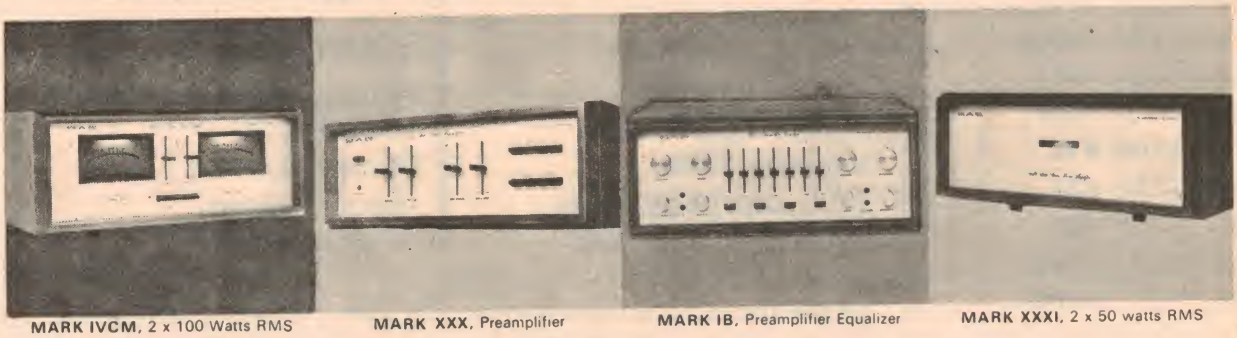

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A.C.T.: Duratone Hi-Fi Cnr. Botany St & Altree Court, Phillip, 2606.

QLD.: Brisbane Agencies, 72 Wickham St., Fortitude Valley 4006.

LER 053

Amcron

BY CROWN INTERNATIONAL

"A NEW STANDARD"

Say farewell to the grand old DC300, and welcome to THE PROBLEM SOLVER, the amp that is going to make your job easier and your customers happier. The original model DC300 was a great amp – the first super-power low distortion amp in the world, when Amcron introduced it five years ago.

Meanwhile, top sound systems designers have used it successfully in hundreds of demanding situations, and made some excellent recommendations for improvements. The response of the Amcron design team was *not* an updated DC300, but a totally *new* and different amplifier, the DC300A. It is the *only* high power low distortion amp specifically *designed* for commercial sound applications. *(CAUTION: There are some large consumer-type amps attempting to sell in the commerical sound field without providing adequate continuous power for all load impedances.)*

Power You Can Count On

One of the DC300A's most outstanding features is that it had *double* the number of output transistors. This means effectively twice the muscle of the old DC300 – at the same price. Each channel has eight 150-watt devices for 1200 watts of power dissipation *per channel*. The DC300A is rated at 150 watts per channel continuous into 8 ohms with both channels driven, 300 w/ch into 4 ohms or 500 w/ch into 2.5 ohms.

Two Amplifiers in One

As a dual-channel amplifier with separate level controls and circuitry for each channel, the DC300A is almost *two* amplifiers in one. This gives you additional flexibility in controlling your speaker load, as when driving separate front and back speaker systems in a large auditorium, or when bi-amping a system. For 600 watts continuous output at 8 ohms, the DC300A converts to a mono amp with two plug-in parts. This makes it possible to drive a 70-volt line directly without a matching transformer.

Superior Output Protection

The DC300A output protection circuitry is a radically new design which completely eliminates DC fuses and mode switches and further reduces service problems to the negligible level. It is superior in every way to the old VI-limiting circuit pioneered by Amcron and now used by most other high power amplifiers, since it introduces *no* flyback pulses, spikes or thumps into the output signal, whether operating as a single-or dual-channel amp.

Gone too is the need to baby the amp by carefully juggling load configurations. The Problem Solver can drive *any* speaker load – resistive or even totally reactive – with *no* protection spikes! Parallel speakers with no deterioration of sound quality, since changing the load impedance only affects the maximum power available, not the ability of the amp to keep on producing clean sound.

Lowest Distortion and Noise

Also new is the DC300A's IC front end, which sets new world's records for low distortion and noise. At the 8-ohm rated output, IM and harmonic distortion is less than 0.05% full spectrum; hum and noise is 110db below. Servicing – if ever necessary – is a snap, since removing the front panel accesses the entire circuitry.

Although it is completely redesigned model, the DC300A has inherited some characteristics from its predecessor.

PRICE $795.00 less than the DC300 sold for.
WARRANTY – three years, covering all costs of parts labor and round-trip shipping.
COOLING – excellent heat dissipation provided by massive cooling fins and the entire chassis itself.
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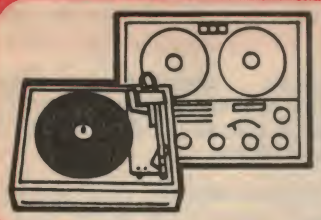


Hi Fi News

The case for omnidirectional speakers

Despite the fact that it was hurriedly arranged, the January 18 meeting of the IREE Sydney Division Audio Group attracted a record audience to hear a lecture by Professor Amar G. Bose, of the Massachusetts Institute of Technology, and Chairman of the Bose Corporation. Prof. Bose outlined to the audience the research which led to the development of his company's omnidirectional loudspeakers.

by NEVILLE WILLIAMS

As many will know, there has been considerable controversy about the design concept of Bose loudspeakers. While the company is not alone in its support of the omnidirectional concept it is certainly at odds with the majority of manufacturers, who favour the conventional enclosure projecting sound towards the listener.

Again, the Bose Corporation is not alone in producing amplifiers with more than the normal power output but, even so, its recently released 1801 stereo amplifier cannot help but attract attention, with its power output rating of 400 watts RMS per channel, into 4-ohm loads, with a measured distortion level of less than 0.1pc.

In fact, amplifiers were barely mentioned at the Sydney meeting and one gathered that they were not regarded as a major problem either by the lecturer or his audience. Amplifier parameters can be set and measured in great detail and almost any level of performance can be achieved — provided you are prepared to pay for it!

The problems in everybody's mind concerned loudspeakers, as heard in a listening room. In this area measurement can go only so far, before it is lost in a maze of uncertainty created by listener reaction itself.

What do measurements really signify? Why do some loudspeaker systems which look promising on instruments sound disappointing to the ear? Conversely, why do people take a liking to systems which appear on instruments to be inferior?

Against this kind of background, it is debatable whether Professor Bose's audience came to learn or to argue! In actual fact, there was very little argument and very little disagreement with what the professor had to say. What set a limit on the meeting, after more than two hours of a solid off-the-cuff presentation, was not lack of audience interest but simply the time limit on occupancy of the Science House lecture hall.

Undoubtedly, one of the aspects of loudspeaker design, which many of the audience had in their mind, was the implication that is sometimes made in literature that a good system can be put together from a multiplicity of cheap units, all operating in parallel. Mysteriously, inherent distortion and inherent limitations on frequency response disappear when loudspeakers are so used, while basic acoustic laws relating to enclosure behaviour obligingly cease to impose limitations on performance.

Such implications are, of course, highly debatable!

In fact, this entirely superficial concept is not identified in any way with Professor Bose and there was no point either to challenge or defend. Instead, he gave a highly interesting account of the work which had led towards the Bose loudspeaker concept. It was abundantly clear that the motivation was to achieve a desired end result, rather than to justify a pre-conceived approach.

It was also abundantly clear that the lecturer was dealing with a favourite topic and what he had to say was phrased in terms very similar to his published papers on the same subject.

The design philosophies put forward are certainly not beyond the realm of debate and some may refuse to accept the weightings given the various subjective factors by the lecturer. However, the philosophies did constitute a stimulating challenge to many accepted ideas and emerged as an ordered justification of the Bose concept.

It is just a pity that there was no time for members of the audience to defend the more conventional approach, and / or question interpretations of certain experimental results. There certainly was scope for this.

If the IREE Audio Group wants to be assured of another packed meeting, it should look for someone prepared to champion the conventional approach with matching enthusiam.

According to the lecturer, his interest in the subject of high fidelity reproduction was sparked off about 20 years ago by the purchase of a hifi system, carefully selected after study of the specifications. The only problem was that it didn't sound right to ears that had become accustomed to real-life music. String tone in particular had an edgy distortion that was both unnatural and offensive.

On the supposition that it was basically a loudspeaker problem, Professor Bose and others, who had become involved, began to evaluate typical high quality loudspeakers on the American market, listening to them and plotting conventional on-axis response curves in an anechoic chamber.

A number of things emerged from the tests, most of them highly disturbing to people accustomed to working with "hard" data. In fact, according to Professor Bose, the main result of the initial research was to demolish all the things they thought they knew about hifi sound reproduction, leaving almost an information vacuum!

Their findings and reactions could be summarised as follows:

CURVES: The response curves obtained at M.I.T. (Massachusetts Institute of Technology) bore little resemblance to those claimed or published for typical

The Bose 901 loudspeaker system pictured on the right has only one forward facing loudspeaker, with two groups of four at the rear angled obliquely at the adjacent walls. The small unit on top is an "active filter" which operates in conjunction with the amplifier, allowing the system response to be adjusted to requirements. At left is the 501 system, more conventional in appearance but still intended to propagate a large proportion of the sound by acoustic reflection.

loudspeakers. Manufacturers and distributors, in general, showed little or no inclination to discuss the discrepancies or justify their claims.

TEST ENVIRONMENT: Discrepancies aside, doubts emerged as to the value of measurements in an anechoic chamber. Even if a system produced a highly commendable result, one could be reasonably certain that no one would ever listen to it under the test conditions. The real problem was to determine how a system would sound in typical home situations.

LISTENING ROOMS: In an ordinary room, proximity of floor and walls must tend to boost the lowest frequencies. Above this, distances and dimensions comparable with wavelength will produce undulations as direct and reflected energy adds and subtracts. Room surface reflections will fill the middle range with an increasing density of peaks and troughs, while presence of the cabinet structure, along with the tweeter design itself, will cause focussing the highest frequencies into a beam. They will be direct and intense on the beam, and randomly diffused off the beam. In short, the listening room is an essential but random part of the total system.

BASIC QUESTION: The incredibly complex propagation effects in a listening room tend to dominate any source, be it artificial or natural. Yet a person with normal, binaural hearing can extract from "the mess" an appropriate sound image. How can one correlate, in a meaningful way, curves taken in an anechoic chamber, the sound pattern in an actual listening room, and the subjective perception of a listener?

LISTENING TESTS: No matter how carefully arranged, audience listening tests are suspect, because they tend to reflect the preferences and the backgrounds of people, as much as the quality of equipment. At best, observations may establish the relative merits of equipments A, B and C without indicating how closely any of them conform to the theoretical ideal. More than that, all three may have desirable qualities which may not be identified as such in a simple preference situation.

"SYSTEMS" APPROACH: A favoured academic approach to many problems is to regard a device as a "black box" or a system, with an input and an output which can be compared precisely to identify any discrepancy. This done, it may be possible to modify the input to obtain a "perfect" output. Loudspeakers defy this approach because their effective output cannot readily be nominated. It is a function of the listening room and varies from point to point in the room.

PERFECT SOURCE: The research problem would be vastly simplified if only it were possible to create an ideal sound source with which practical loudspeaker systems could be compared, not only by means of listening tests, but by detailed computer study of sound output to quantitise differences.

Professor Bose said that the conviction

(Continued on page 14)

Omnidirectional Loudspeaker from Philips Elcoma

In the context of omnidirectional loudspeaker systems, it is appropriate to include a reference to the new and interesting Quadreflect system from the Elcoma Division of Philips Industries Limited.

Developed entirely in Australia, the Quadreflect system employs seven loudspeaker units in all — four 7-inch woofers and three 1-inch dome tweeters. One woofer and one tweeter face forward through the front grille, providing the direct sound; the

remaining three loudspeakers face towards the rear.

Dimensions of the enclosure are 43cm wide, 36cm high and 34.5cm deep, providing an effective volume of 28.3 litres or 1 cu ft. The enclosure is of the fully sealed variety, internally damped with Innerbond. While the woofers have a very low natural resonance, the sealed environment pushes this up to a system resonance of 70Hz — an agreeably low figure considering the total cone area. The actual bass response extends well below this.

Frequency division between woofers and tweeters is provided by networks involving both inductance and capacitance, giving a cross-over frequency of 1600Hz.

Nominal impedance of the Quadreflect is 8 ohms, with a power rating of 80W RMS — a notably high figure for so compact a system. What is more, it is a meaningful 80W, because the sensitivity is well up to the average for compact designs.

Philips Elcoma prefer to sell the Quadreflect system completely assembled, tested and packaged. In teak, the recommended retail price, including sales tax, is $224. Walnut is slightly cheaper at $220.

For those who prefer to "roll their own," Philips can supply a partially assembled do-it-yourself kit for $153 in teak or $150 in walnut, both prices including sales tax. The stand is $21 extra.

The kit includes loudspeakers, frequency dividing components, Innerbond, connecting wire and woodwork partially assembled. The constructor must provide the finishing materials (glue, stain, &c) make up his own front fret and provide covering for the cones at the rear.

Recommended position in a room for a pair of Quadreflect systems is along a hard plain wall, about 15cm from the wall and 90cm in from each corner. The idea is that reflection from the walls will diffuse the sound and get away from the "point source" effect. An Elcoma representative suggested that, under the best complementary listening conditions, the reflected sound tends to bring the effective source forward to envelop the listener, achieving a "surround" effect.

In fact, of course, dependence on adjacent wall surfaces is at the one time a feature and a limitation of the general class of enclosure. If the room layout is appropriate, advantage can obviously be taken of the idea; if it is not, sound projected to the rear will tend to be absorbed by furniture and drapes.

Much the same would apply to the claim about "surround" sound. In some listening rooms two omnidirectional loudspeakers may work in well with the decor; in others it may be easier to achieve surround sound with four "shelf" enclosures fed with quadraphonic signals. A system which is as strongly "individualistic" as the Quadreflect tends to promote very positive acceptance — or rejection!

Our own listening tests were done in a home situation which was probably average —neither well suited nor badly suited to the Quadreflect systems. As such we tended to react to them in terms of appearance, price, ratings and sound, without too much emphasis on their non-directional qualities. Their response is wide and smooth, perhaps a little down in the extreme treble and with some suggestion of a prominence in the bass register above 100Hz. If the style appeals, they are certainly worth closer personal evaluation.

Footnote for organ enthusiasts: the Quadreflect, with its generous power rating and omnidirectional character is a "natural" for an organ extension speaker in the home.

gradually grew that it might be possible to create a practical transducer which, with suitable electronic compensation, would substitute for the supposedly "ideal" transducer — a pulsating sphere with no resonance, no distortion and capable of launching an acoustic wave the exact counterpart of the electrical input wave.

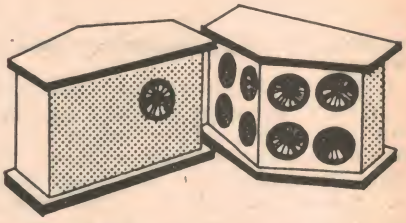
Then came an idea of using a spark as a repeatable "point source" of natural sound. It could be suitably positioned, along with a microphone, in a reference, but otherwise normal room. The sound could be studied and quantitised by computer so that its characteristics would be known in minute detail.

If the sound could be reconstructed electrically, reproduced through a neo-spherical loudspeaker assembly, and processed through the same microphone and computer, its discrepancies could be identified, then counteracted electrically by feeding to it a computer-modified input. The result should be a total system with near perfect characteristics.

The assumption behind this is that, if the response of a system to a narrow pulse is known, it would be possible to calculate the response of the system to any other input.

Various problems had to be overcome before the idea could be put into practice. For example, a single spark discharge has so little energy relative to the ambient that there was no hope of analysing its content in sufficient detail.

To overcome this problem, a scheme was devised which caused the spark to repeat at intervals a second or more apart, allowing



The Bose 901 system, pictured on page 11, has one full-range loudspeaker facing forward, and eight to the rear. Thus only about 10 per cent of the total sound field is projected directly towards the listener.

enough time for room echoes to die down in between. A second microphone, closer to the spark than the listening mic, served to inform the computer that another spark impulse had been propagated. By this means the real time computer was able to build up a record of the spark sound, in additive fashion, while the random ambient did not similarly add.

Fortunately, by this time, the work had been granted official recognition by M.I.T. as a research project and sufficient computer time had become available, albeit on an after-hours low-priority basis.

With a computer record available of a wide spectrum reference sound, the next step was to build up a neo-spherical enclosure carrying an array of small diameter outwards facing loudspeakers. By feeding into it the reference signal and monitoring

the output from the same microphone in the same position in the same room, the discrepancy between reproduced and reference spark could readily be noted and analysed. By suitably compensating the input signal, a "perfect" output could be expected and, in fact, seems to have been achieved.

Furthermore, given generous amounts of computer time, it became possible to analyse actual musical signals, to predict how the practical loudspeaker would distort them, and then to pre-distort the signals so that they would emerge as from a idealised pulsating ball reproducer. It was an extremely tedious task, consuming at least seven minutes of computer time for each second of musical program.

But the end result was a total system that, by definition, should have been perfect. Unfortunately, while it was an obvious improvement, it still exhibited some of the edginess of an ordinary loudspeaker system. It was a small yield for a huge amount of work, and the project more or less ground to a halt.

Next step was a growing suspicion that the edginess of recorded string tone had something to do with any situation which causes the listener to receive an excessive proportion of a given sound directly from the source, and particularly with the input to the respective ears in a fixed phase relationship.

Professor Bose reminded the audience of the effect when one listens to a voice very close to a person's mouth. The sibilants are exaggerated and, while it betrays a high degree of intimacy, it is not necessarily a pleasant effect. The same goes for very close microphone placement with instruments.

Professor Bose said that, working along these lines, a number of prominent conductors were invited to listen through headphones to recordings of their concerts, made for the purpose by an M.I.T. team. Without telling them of what was going on, engineers introduced a certain amount of L+R mix into the signal. Almost invariably the conductors reacted as if something had gone wrong with the "tone" of the strings.

(There is room for argument about what this really means. Mono on headphones is totally unnatural because it seems to locate the sound source inside the listener's head. It does not follow that the sound has been otherwise distorted or that the subjective reaction is the same as when listening to a discrete source external to the head.)

Also, about this time,, someone in the research team realised that they were merely discovering what had been well known for some time to designers of auditoria and more recently to recordists. Whether for direct listening or recording, there was an optimum mix between direct sound and that from auditorium ambience.

Now readily available from stock, this Marantz 4230 receiver features in-built Dolby circuitry and a "vario matrix" decoder to cope in broad terms with all systems. Provision is made for plug-in or add-on units for specialised decoders or discrete tape sources. The receiver includes an AM and FM tuner, and a very wide range of input and control facilities. In quadraphonic mode the receiver provides four 12W RMS channels. Alternatively, the amplifiers can be interconnected to provide two 30W stereo channels. (Information from Aureima Australasia PTY Ltd, 15 Orchard Rd, Brookvale, NSW 2100.)

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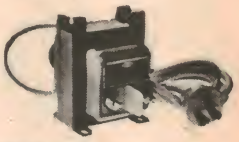

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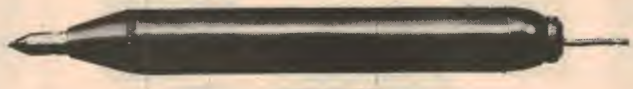

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While it varies with frequency, it is largely a function of distance. Direct sound diminishes rapidly as one moves away from the source. Ambient sound is fairly constant throughout the auditorium. The optimum listening or microphone position for subjectively pleasant sound tends to be in the area where the two curves intersect.

These statements about proximity and signal phase had important implications in respect to microphone placement and, in particular, to the multi-mic close-up technique. Brief discussion in the audience at Science House was sufficient to indicate their misgivings on the same subject. The close-up, multi-mic technique might be good for certain dramatic and spatial effects, but it was suspect for recording serious performances.

(One seeming inconsistency invited challenge. Professor Bose's argument began with the statement that he had rejected violin tone from a hifi system, as a person who was currently playing the instrument. Yet a violinist is the one person who hears his own instrument at very close quarters, almost exclusively by direct radiation).

CR02 Tape From 3M

The 3M company has recently concluded an agreement with E. I. DuPont de Nemours & Co which enables 3M to manufacture magnetic tape using chromium dioxide pigment. The company claims that they have been deterred from producing "Scotch" CR02 tape earlier because equipment was not sufficiently standardised. The new tape will feature 3M's "Posi-Trak" backing, currently incorporated in its high energy and low noise cassettes.

It was about this time that the lecture had to come to an end, but the message was clear enough:

Within the limited dimensions of an ordinary listening room, it is not wise to squirt the sound directly towards the listening position. It may ensure a firm stereo image and a full quota of high frequencies, but the predominance of in-phase signal from each localised apparent source may prompt a subjective sense of sibilance and edginess to well known sounds, producing a hard-to-define dissatisfaction and long term listening fatigue.

A more acceptable approach is to radiate most of the sound into the listening room from sources diffused by deliberate reflection from hard surfaces adjacent to the transducers. Hence the Bose concept of multiple loudspeakers radiating outwards from an irregular enclosure, with most of the transducers facing away from the listening position.

While there is every reason to ensure that the individual transducers have the best possible characteristics, Professor Bose claimed that a diffused sound is so much more pleasant than beamed sound that listeners tend to overlook some discrepancies in frequency response. This could conceivably explain some of the plainly exaggerated claims which have sometimes been made for obliquely radiating systems.

For somewhat similar reasons, a case can be made for increasing the number of transducers in the listening room, even if they are electrically connected in parallel.

Questioned about matrix quadraphonic systems, the lecturer said that he did not accept that four signals encoded into two channels could be recovered in their original form. While the discrete system had more to offer in this respect, he felt that we really needed to know a great deal more than we do about recording and recreating the acoustic environment. It was even possible that an appropriate environment could be synthesised by a computer rather than recorded and reproduced by somewhat dubious methods.

In a personal discussion after the lecture, I indicated to Professor Bose that I liked the dimensional effect of quadraphonic reproduction, quite apart from argument about whether individual sound sources were precisely located, or relocated. I asked him:

"Is it not possible that the dispersion of sound sources and phases is accomplishing a subjectively desirable result, in line with your own argument, even though you have condemned the mathematics of the method?"

To this question, the answer was a firm assent, and there the evening ended.

Does this mean that we should all throw away our existing boxes and buy the requisite number of Bose systems?

Undoubtedly such an idea would be supported stoutly in Australia by Wedderspoon Pty Ltd, who represent the Bose Corporation in this country.

Support would also be forthcoming from the Philips Elcoma Division, which is currently pushing the locally developed "Quadraflect" system.

Just before you do take such a step, it would be wise to look at the layout of your listening room.

It would be a rather futile exercise to buy two or more rearward facing systems, only to stand them against curtains, or tuck them snugly into a corner, or hard against a cabinet of one type or another. To "do their stuff", they normally have to be positioned at a suitable distance from a hard wall, and relatively clear of any kind of acoustic obstruction.

You couldn't tolerate such a requirement? Then best you stick to your directly radiating boxes!

You have conventional enclosures but the sound is too edgy, too intrusive? Well, go back and read over what has been said.

You don't like conventional enclosures, and you don't like unconventional ones either? What about taking up home movies?

MAGNECORD AGENCIES

Magnecord International Pty Ltd announce that they will be handling agencies which were previously handled by Magna Techtronics. These include: ELAC: Turntables and cartridges. FISHER: Amplifiers and loudspeakers. NAKAMICHI: Professional cassette decks. DBX Inc: Compressor-expanders and noise reduction systems.

Magna Techtronics Australia Pty Ltd will concentrate in future on industrial electronics equipment, principally for recording studios, TV and radio, and film making.

Mr A. J. Muldoon, previously with Magna Techtronics, will be Sales Manager of Magnecord International.

HIFI NEWS

High quality Australian amplifiers

A little known Australian company, Harvey Mayer Electronics, has recently released a range of high quality stereo amplifiers. A letter from the company, reproduced below, is indicative of the problem faced by many Australian companies in establishing a name for themselves against stiff overseas competition. The letter reads as follows:

The purpose of this letter is to introduce you to our range of stereo amplifiers in the hope that you will include some of the information supplied in your magazine. We are an all Australian company now entering our second year of production, and a number of Victorian retailers are currently stocking our available models.

Through experience we have learnt that to have a good sound product is not enough, and we are seeking assistance, through magazines like your own, to overcome this major problem. The most common reason given for not choosing a Harvey Mayer is that we are not a known brand, and we are finding this a little hard to take in view of the fact that so many brands are not, in our honest opinion, up to scratch with our own products.

We aim to supply a range of products which can be built up to high quality systems, and our program is near completion of stage one; ie, the production of three different high performance stereo amplifiers to suit individual needs, each being a solid state integrated stereo amplifier with low distortion, clear transience, high damping and with connections for simulated quadraphonics using a subtractive matrix mode.

Information to hand with the above letter indicates that Harvey Mayer Electronics are offering three competitively priced high quality amplifiers. These are the Model 30AT, 50AS, and 100AR featuring power outputs of 15W, 25W, and 40W RMS per channel respectively. Main features of these new amplifiers are a comprehensive range of inputs and outputs and low THD figures (generally less than 0.2pc at rated output).

Pricing structure of the new amplifier range is as follows: Model 30AT, $161.00; Model 50AS, $229.00; Model 100AR, $289.00. (All prices given are recommended retail prices.) For further information contact Harvey Mayer Electronics, 21 Kingsley Crescent, Mont Albert, Victoria. 3127.

Pipe organ concept in EPI Microtowers

Retailing for around $100.00 each, these EPI MicroTower loudspeakers (pictured at right) are suitable for use with amplifiers rated at only 5W RMS per channel, yet are capable of handling power outputs of up to 50W per channel.

This new omnidirectional speaker employs the pipe organ concept to achieve good bass response, whilst at the same time eliminating the most expensive part of a speaker system: the woofer. Instead of the usual configuration of tweeters and woofers, this deceptively simple new design uses two full-range 4½" drivers to produce high and mid-range frequencies. Low frequency response is augmented by the tuning effects of the enclosure.

The compact size of the new loudspeakers allows them to be placed almost anywhere in the listening room. Hand rubbed walnut cabinets and rich black grills give these speakers a handsome contemporary appearance that should blend well with any decor.

For further information contact Auriema (Australasia) Pty Ltd, PO Box 604, Brookvale, NSW. 2100.

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You will find that the little A-10 delivers unexpectedly "big sound". At the other extreme, the A-50 can accommodate larger amounts of low end power with low distortion and crisp definition hitherto unattainable in an enclosure of such compact dimensions. For sheer value, however, the A-25 is clearly the winner. It demands comparison with speakers two and three times its cost. The new A-35 is a sonic refinement of the A-25 with a different crossover in a more complex cabinet design which wrings the last iota of performance from a moderately larger and more expensive system.

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HIFI NEWS

New Teac A-360 Cassette Deck

Australian Musical Industries Pty Ltd now have available the new Teac A-360 stereo cassette deck which has many of the features of the top of the line model A-450.

Major feature of the A-360 is the new transport mechanism with claimed wow and flutter of only 0.07 pc. Teac state that this low figure is achieved firstly by the new heavy-duty outer rotor motor which drives the very large capstan flywheel having a diameter of 90mm. Teac claims this the largest capstan flywheel yet used in a cassette deck. At the same time, the capstan itself is highly polished to a surface finish of 0.15 micron.

An improved flashing tape run indicator, as used on the top-of-the-line A-450 model gives a highly visible sign that tape is running. Memory is incorporated in the tape revolution counter for easy reference back to a given section of the tape.

A high density ferrite record / playback head is featured. This is claimed to have extended life over conventional heads, increased dynamic range, reduced bias requirement and a hyperbolic shape for improved high frequency response.

Naturally, Dolby B. Noise reduction is incorporated in the deck electronics. It also has three-position bias and equalisation switches so that all possible varieties of cassette tape can be played with maximum fidelity.

Two large level meters give accurate indications of recording and playback signals. They are backed up by a light emitting diode indicator which flashes instant warning of overloads by transients which are not shown by the meters.

Further information on the Teac A-360 and other new cassettte deck models recently released can be obtained from the Australian distributors, Australian Musical Industries Pty Ltd, 155 Gladstone St, Sth Melbourne, Vic.

Retailing for around $258.00, the Ferrograph 20 + 20 stereo amplifier is distributed in Australia by Leroya Industries Pty Ltd, 266 Hay Street, Subiaco, WA. As its name suggests, rated power output is 20 watts per channel into 8 ohm loads. Other features include switchable treble filters and comprehensive signal switching facilities.

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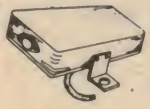

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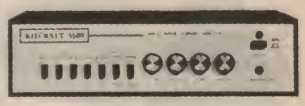

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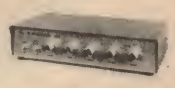

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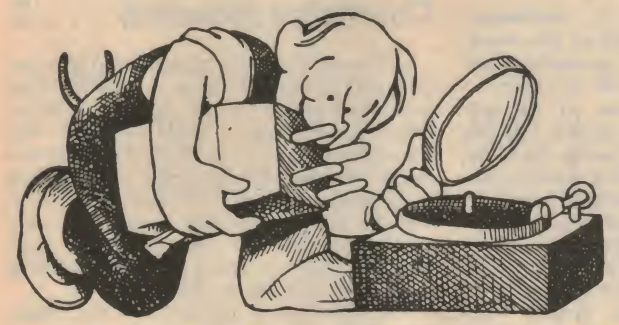
HOW IMPORTANT IS AUDIO-COMPONENT COMPATIBILITY?

Julian Hirsch examines some of the obscure factors that affect just how well the separate units of your hi-fi system will work together

Julian Hirsch, of the Hirsch-Houck Laboratory is a well known writer on hifi topics. This article is reprinted from the January 1974 issue of Stereo Review. Copyright 1973 by the Ziff-Davis Publishing Company.

Webster defines *compatible* as "capable of coexisting in harmony." The combination of words rather pleases me, because the kind of compatibility I am about to examine has a great deal to do with harmony — of the musical variety. In short, *non*-compatible audio equipment produces *non*-harmonious sound; it generates harmonic and unharmonic distortions and a variety of other nasty sounds.

The various parts of your component audio system, as you may perhaps have discovered by yourself, can be mixed — within certain limits — but they must be matched as well. From the phono cartridge at one end of the reproduction chain to the loudspeaker at the other there are a number of "interfaces," interactions, or interconnections between the component links, each of which offers an opportunity for the signal to be adversely affected if the two components are not properly matched at that point. Let us examine what these interfaces are, what can go wrong at each of them, and what should be done to avoid possible trouble. We will begin at the beginning, with the phono cartridge, and address ourselves to the first interface: that between phono cartridge and tone arm. (We will not be concerned in this examination with a component's actual performance, except as it affects the proper operation of other parts of the system.)



Phono Cartridge/ Tone Arm

Although these two components are often bought separately, they act as a unit and must be considered as such. The function of the tone arm is to support the cartridge in the correct physical attitude in respect to the record surface, guiding it as its stylus traces the microscopic gyrations of the inward-spiraling record groove. The motion imparted to the stylus (relative to the cartridge / arm system) generates the output voltage — the audio signal itself — and the arm must not respond in any way to the modulations in the record groove; such response is the business of the stylus only.

And just here is our first potential mismatch — the mechanical resonance established by the compliance (springiness) of the stylus assembly within the cartridge and the total effective mass of the arm-and-cartridge combination. This resonance occurs at a very low frequency — usually under 20Hz.

At frequencies far below arm-mass / stylus-compliance resonance, the entire arm follows the stylus movement. When this happens, there is little or no relative movement between stylus and cartridge body, and therefore no output signal generated.

At the resonant frequency both the stylus and the arm move with a greatly exaggerated amplitude. If, therefore, the pickup resonance is excited by the record, there is a large subsonic ouput voltage from the cartridge. This need not, in itself, cause any problems, since it can (and usually will) be filtered out by the amplifier circuits. However, the stylus deflection may be so large that it exceeds its linear range, and this causes intermodulation distortion and mistracking of the recorded signals in the groove. In severe cases, the vibration at resonance may even exceed the force holding the pickup in contact with the record, and groove skipping will result.

Since the stylus almost never encounters recorded signals below 20Hz (or even 30Hz), one might wonder what could trigger the arm's resonance; record warps, which are present to some degree on most commercial pressings, are responsible.

Oddly enough, the obvious warps, such as the simple "saddle" warp that causes a once-per-revolution up-down pickup movement, are not a major troublemaker, for their 0.5Hz warp rate (at 331 / 3 rpm) is far removed from the tone arm's resonant frequency. "Pinch warp," however, which resembles an abrupt "jog" in the disc surface, appears to the tone arm as a transient signal with a frequency between 2 and 10 Hz, with the most severe instances likely to be at about 4 or 5Hz.

If a tone arm / cartridge combination with a 5Hz resonance is used with a record with a 5Hz warp frequency, mistracking is almost unavoidable. Moving the resonance below 5Hz might solve the pinch-warp tracking problem, but it would also cause mistracking of the gentle saddle warps or response to the not unusual defect of off-centre spindle hole.

If the resonance is moved above 5Hz, one can be reasonably sure of tracking almost any "normally" warped record — except

COMPATIBILITY

that care must be exercised to keep the tone-arm / cartridge resonance below the lowest musical frequencies on the disc if the recorded material is to be reproduced at the proper level and without mistracking.

Though the exact resonant frequency is not critical, it is generally agreed that 10Hz is about optimum from the standpoint of tracking recorded program material with a minimum response to record warps. A range of 7 to 15Hz could be considered acceptable.

Now how can the buyer select his tone-arm / cartridge combination for an optimum resonant frequency? In most cases he probably can't, but it is not too difficult to avoid really serious problems.

A lower resonant frequency results from an increase in effective arm mass, an increase in cartridge compliance, or both. There is little point in attempting to calculate the resonance of any particular combination, however, since few record-player manufacturers specify tone-arm mass, and cartridge vertical-compliance ratings are notoriously imprecise.

But, as a rough guide to typical values in today's components, a cartridge designed to track at 1 gram will usually have a compliance between 15 and 60 micro-centimetres per dyne. A good tone arm (including a typical cartridge) may have an effective mass somewhere between 14 and 30 grams. In extreme cases, combinations of these components could resonate at frequencies of less than 4Hz or as high as 11Hz.

Obviously, a very high-compliance cartridge should be used only in a low-mass arm to keep its resonance safely above that lower limit.

At the other extreme, a stiff (low-compliance) cartridge should not be used in a very light arm. Fortunately, this is an unlikely combination, since low-mass arms are expensive and low-compliance cartridges are inexpensive. But if it were to occur, the resonance might be moved up into the low audio range, with the attendant risks of acoustic feedback, exaggerated rumble, or loss of low-frequency response.

Finally, we would suggest, if you have a question about the compatibility of any particular cartridge / tone-arm combination, that you contact the manufacturers of both the record-player arm and the cartridge for their opinions.

Phono Cartridge/ Preamplifier . . . 1

The phono-input sensitivity of an amplifier or receiver is defined as the smallest input-signal voltage in milli-volts (mV) that will drive it to its rated power output with the volume control set at maximum or, with a separate preamplifier, to the rated output voltage.

The phono cartridge's rated output is the voltage it will develop (at 1,000Hz) across a standard load (normally the 47,000 ohms presented by most amplifier phono inputs) when playing a test record with a standard recorded velocity — 3.54 centimetres per second is used in our own cartridge tests.

Now, 3.54 centimetres per second is a rather moderate recorded level. Some records contain peak signal levels as high as 30 to 40 cm / sec, and optical studies of discs have revealed occasional high-frequency peaks on the order of 80 cm / sec. Considering that a typical good-quality phono cartridge has an output of 1mV for a 1-cm / sec recorded signal, a phono-preamplifier sectinn or receiver ought to be able to handle —as a minimum — inputs in excess of 40mV without being driven into overload distortion (clipping).

Another aspect of cartridge / preamplifier compatibility is the "sensitivity" or amplification available through the preamplifier input. The preamplifier section should have gain enough (be sensitive enough) that, with a given cartridge, the amplifier can be driven to its full output on the loudest recorded passages with the volume control well below its maximum setting, and preferably at about the same setting as is used for other program sources, such as a receiver's built-in tuner.

(If the amplifier operates at normal listening level with the volume control about half on, it is an indication that the signal input is at about the level intended for the amplifier. It also indicates a comfortable margin of gain to cope with the occasional low level recording. Ed. E.A.)

Satisfactory phono-input sensitivity can be tested for right in the dealer's showroom, using cartridges of known output (the manufacturer's specifications are usually adequate for this purpose).

Phono preamplifier overload is a bit more difficult to judge, since it shows up only on the loudest recorded peaks as an irritating distortion that is present no matter what the volume-control setting. It should not be confused with the distortion generated by a cartridge being operated at too low a tracking force, however.

It should also be noted that many audio shops use separate preamplifiers between their demonstration turntables and the normal preamp inputs. The purpose is a perfectly legitimate one — to avoid the problems generated by the necessarily long leads needed with their complicated in-store switching systems — but it is then impossible to judge preamp overload or sensitivity.

Almost all good components today have phono-input overload levels higher than 40mV. Values of 60 to 80 mV are not uncommon, and some can handle more than 200mV. It would seem that phono overload is perhaps not really a serious problem. When using a high-quality cartridge (which usually has a low-to-medium output) with most modern amplifiers, this is certainly true.

If your budget is limited, keep in mind that the lowest-price cartridges in most manufacturers' product lines may have twice the output of their better units, and in the lower-price amplifiers (as well as some highly regarded expensive models of only a few years ago) the phono overload may occur at levels as low as 25 to 30mV. Such an unfortunate combination could sound highly unsatisfactory, to say the least.

Some amplifying equipment has a hi / lo phono-sensitivity switch on its rear panel to accommodate cartridges with widely different output voltages. On equipment that offers this feature, we suggest starting with the switch in the lowest-sensitivity position — meaning that the volume control will have to be advanced further than with the high-sensitivity setting to achieve the same volume level.

If you can achieve a comfortable listening level before the volume control reaches the upper third of its range, and if no hiss or hum is audible when the pickup is raised from the record, this is the amplifier's preferred operating condition with the cartridge being used — which is to say that it offers the best overload margin.

If noise is excessive or if the volume control must be advanced to its limit, then the other switch setting should be used. In that case, it is usually safe to assume that the cartridge output will not overload the phono preamplifier. Good modern equipment designed without such a switch (or hi- and low-sensitivity phono jacks) can usually be assumed to be free of potential phono-overload problems.

Cartridge/preamp . . . 2

Almost all magnetic phono cartridges are designed to operate with a specific load resistance (usually 47,000 ohms), and this is therefore provided by every amplifier with a magnetic phono input. The total electrical circuit faced by the cartridge — consisting of its own inductance, the load resistance, and the shunt capacities of both the connecting cables and the amplifier input circuits — plays a vital part in establishing its overall frequency response.

The mechanical portions of the phono cartridge — its jewel tip, the stylus cantilever, and the voltage-generating elements — frequently resonate with the record material at the highest audible frequencies or just above them. The electrical circuit usually serves to equalise the high-frequency resonance (which is generally mechanically damped as well) so as to produce the flattest frequency response over the audio bandwidth.

A higher-than-rated load (such as the 100,000 ohms offered as a switch-selected option on some amplifiers) will increase the high-frequency output and brighten the sound, while a lower resistance (25,000 to 30,000 ohms is provided by some of the amplifiers referred to) will roll off the highs.

Although the input resistance is specified, the capacitive portion of the load is ignored by many cartridge and amplifier

IMPORTANT NOTICE

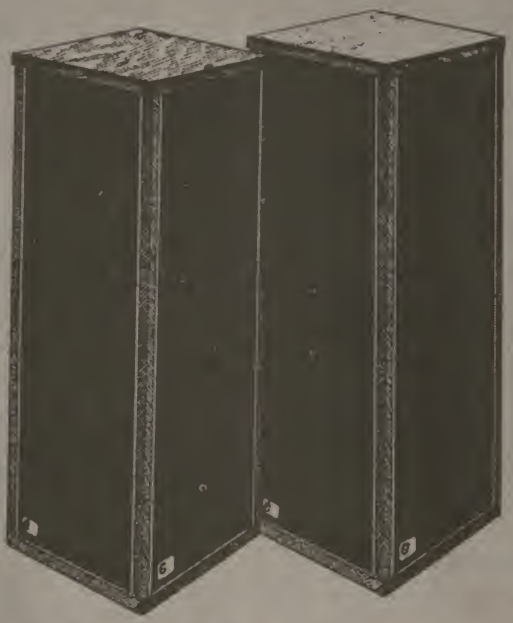
TO ALL PEOPLE GENUINELY CONCERNED WITH SOUND REPRODUCTION

THIS ANNOUNCEMENT IS OF VITAL IMPORTANCE TO YOU

From Massachusetts USA, come EPI linear loudspeakers, a significant breakthrough in loudspeaker performance. Acclaimed by audiophiles throughout the world for such design accomplishments as the EPI Tower, which is rated by the "Stereophile" list as being one of the top five loudspeakers currently available in the world.

To those that are unfamiliar with EPI, the initials stand for Epicure Products Inc. The company is a collective of audio experts and engineers who banded together in 1968 to form a progressively minded company. Many of them had previously played a significant role in loudspeaker design and production for such organisations as AR (Acoustic Research) and KLH, but it was their realisation that the larger companies did not honestly want to offer linear loudspeakers to the consumer. This led EPI to the decision that a new company might successfully compete with the present day giants in producing speakers whose performance would not only be better but whose cost would be less.

EPI manufacture eight loudspeaker systems. Each system, in its own way, an attempt to provide what EPI believe to be the best possible sound reproduction in its price class. Ranging from the least expensive Model 50 "Mite," on which Audio Magazine in November 1971 commented: "The response exceeds from 45-16000 ± 3dB and dispersion was also excellent in our listening test, the Model 50's transient response stood out and we found we could feed the unit a lot of power before it would break up. An open sound with clear highs and solid bass is characteristic of this stereo pair."



EPI MODEL 400

To the most expensive Model 1000 Tower which produces the ultimate in sound quality, but at 6½ ft tall, 180 lbs and $1000 each, these majestic columns are out of reach of all but the most devoted and enthusiastic music lovers.

Nevertheless, regardless of price and size all EPI speakers have a technically unbiased sound, that is, they are designed to reproduce the musical signal exactly as it is when it arrives at the loudspeaker terminals without colouration, tone compensation or added presence.

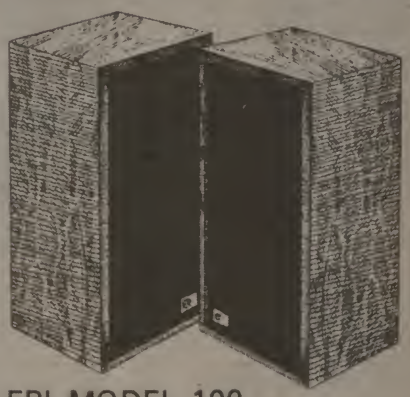
* And this is where loudspeaker differentiation occurs. Most other sound reproducers alter the original signal by creating exaggerated midrange peaks, which give the loudspeakers a sense of added presence; or they have the inability to accurately reproduce every audible note, whether it be from "The Voyage" by the Moody Blues or Beethoven's "Ninth Symphony".

So may we suggest, before purchasing your loudspeakers, that you give careful consideration to your final choice and allow your ears to experience the accurate harmonics, low distortion, omnidirectional radiant energy and flawless transient response that make EPI speakers a never tiring experience.

For further information, brochure and dealer list: Please write to Auriema (A'Asia) P L, Box 604, Brookvale, NSW 2100.

THE LINEAR RESPONSE OF EPI*

OF MASSACHUSETTS USA



EPI MODEL 100

Our new 60-watt receiver. For people who want more power than a 100-watt receiver.

It isn't hard for some high fidelity companies to turn a 40-watt receiver into a 100-watt receiver. All they have to do is overestimate their own power.

Instead of testing their receivers at every audible frequency, for instance, they use one easy-to-reproduce frequency. Or they use "peak power" or "IHF" watts instead of true RMS watts. Or omit distortion figures.

This is similar to computing a golf score by counting only the best holes. The results look terrific but they don't correspond with reality.

You can avoid this sort of inflation by buying the new Harman-Kardon 630 receiver.

The 630 produces 30/30 RMS watts at less than 0.5% total harmonic distortion from 20Hz to 20kHz, both channels driven simultaneously into an 8-ohm noninductive load at standard line voltage.

Which is more than many 100-watt receivers can say, and that's why they don't. (If the power rating of a receiver isn't phrased exactly this way, you owe it to yourself to be suspicious.)

But the 630 not only gives you more power than so-called 100-watt receivers; it makes better use of the power.

The 630, like our 90-watt receiver (the 930), uses a unique system called "twin power."

Other receivers have only one power source, which lets them function perfectly well with quiet musical passages. But when a sudden tone burst comes along, one channel robs the extra power it needs from the other channel—weakening both and creating distortion in the process.

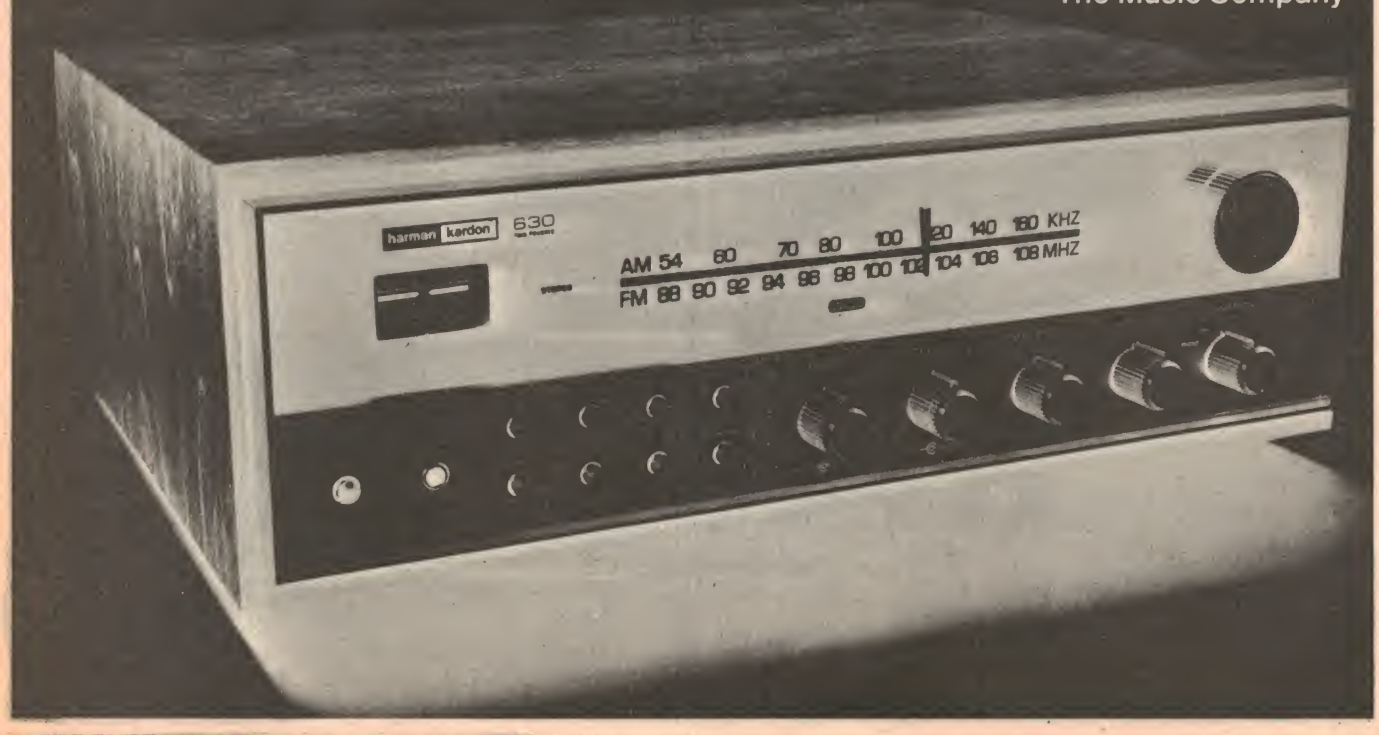
The 630 eliminates this in-fighting between channels by having an independent power supply for each. So no matter how difficult the musical passage, both channels can handle it flawlessly.

Of course, all of this has a price. Fortunately, it's a moderate one: $398.

For that, you can buy a receiver with more watts than ours. But you can't buy one with more power.

For more information, write to Jervis Australia, P.O. Box 6, Brookvale, NSW 2100 or phone 939-2922

harman / kardon
The Music Company



COMPATIBILITY

Continued

manufacturers. Some have based their cartridge performance on a "typical" capacitive load such as 250 to 300 picofarads (pF), although this is rarely stated in so many words.

At the other extreme is the case of the CD-4 (four channel "discrete") cartridges offered by JVC and Audio-Technica. To achieve their 45,000Hz response, the load capacitance must be reduced to an absolute minimum (preferably 100pF or less), and CD-4 demodulators are supplied with special low-capacity cables to replace those normally used with record players. These cables are quite short, which can cause installation problems in some cases. The demodulators also present a high load resistance to the cartridge to further enhance its high-frequency response. However, other cartridges, which may well be on the market by the time you read this, have a much lower coil inductance and should be able to operate with any normal cable capacitance when playing CD-4 discs.

Although cable capacitance is a relatively noncritical factor (except for CD-4 service) in home music systems, it may be partially responsible for some of the differences heard between a dealer's showroom demonstration and the performance of the same components in your own home.

As mentioned above, the audio switching systems used by most audio dealers may require undesirably long cables leading from some of the record players on their shelves. To avoid penalising some cartridges with excessive cable capacitance, they use small "outboard" RIAA preamplifiers near the record players, connecting their outputs to the AUX inputs of the amplifiers.

This may be the fairest way to compare different loudspeakers or cartridges, but it can sometimes be misleading when comparing amplifiers, since their phono-preamplifier sections are by-passed. The sonic differences attributable to the phono preamplifier are usually minor, but in some cases they can be significant. It would be well to verify that the system you are considering is being operated in the showroom exactly as it will be in your home.

For the same reason, when comparing two cartridges, be sure that they are played through the same amplifier and speaker systems. Sometimes the audible difference between two cartridges really results from the amplifer that is being used to compare them.

Turntable and Loudspeaker

Rumble is the audible effect of mechanical vibration (usually from the motor and idler wheel) in a turntable system being interpreted by the phono cartridge as a low-frequency signal in the record groove. Turntables differ widely in the level of their rumble, and in its frequency composition as well. Expensive turntables are naturally likely to have less rumble than cheaper models, although the law of diminishing returns sets in rapidly above $150 to $200.

In general, rumble signals are generated at the frequency corresponding to the motor-rotation rate (25Hz for the 1,500-rpm motors used in almost all automatic turntables and in many single-play models), and at its harmonic frequencies. The idler wheel, which usually has a basic rate of about 4Hz, also may introduce that frequency and its harmonics. Some turntables use lower-speed motors with corresponding rumble frequencies of 4 to 8Hz; others use belt drive to avoid the idler-wheel problem entirely; still others combine both methods.

At the top of the price scale are direct-drive turntables whose motor armatures turn at the 33 1/3-rpm record speed and (in theory, at least) have little or no rumble at frequencies above a few hertz.

Instead of being a single low-frequency tone, rumble is actually a complex signal whose frequency spectrum may extend from 0.5Hz to higher than 100Hz. The characteristics of human hearing and loudspeaker frequency response combine to make the higher rumble frequencies much more audible than the lower ones, even though they are usually considerably weaker.

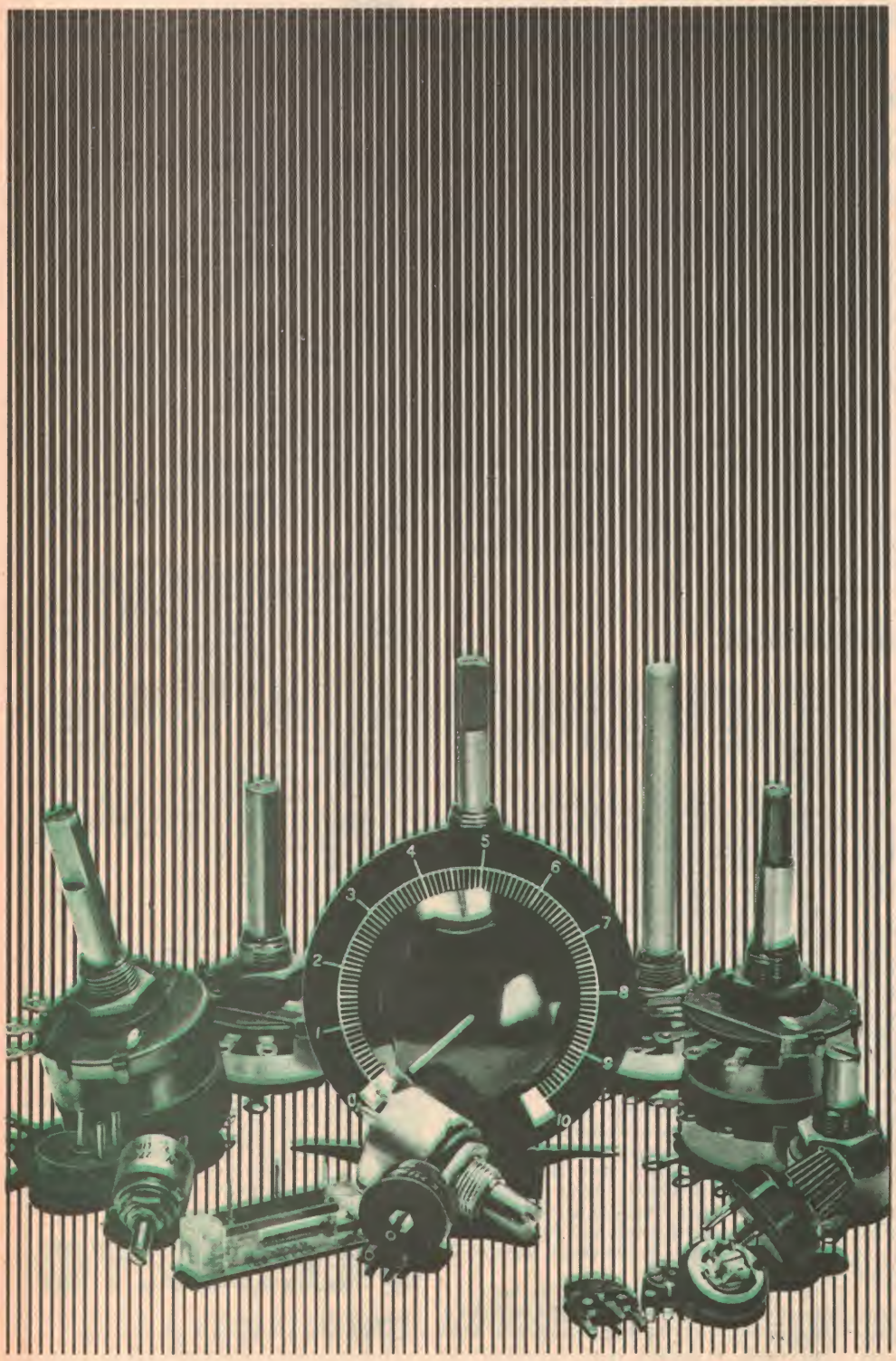
To take this into account, the "unweighted" rumble measurement (which responds equally to all frequencies) is often supplemented or replaced by a "weighted" measurement. This typically attenuates the measured levels at a 6dB per octave rate with decreasing frequency. In other words, a 50Hz rumble signal would provide twice the reading of a 25Hz signal of exactly the same strength.

The weighting curve is supposed to account for the relative audibility of different rumble frequencies, and it is reasonably effective for that purpose. However, "inaudible" rumble can have very audible side effects.

Suppose, for example, that a defective idler wheel introduces a strong 4Hz rumble. No speaker can reproduce that frequency, and no person could hear it if it were reproduced. However, some amplifiers have a frequency response extending down to the sub-audible range, and are therefore capable of passing a 4Hz signal through to the speakers.

At such low frequencies, the woofer's cone excursion can be very large, even at a moderate drive level. This is especially true for vented, or ported, speaker systems, in which the woofer cone is virtually unloaded at subsonic frequencies.

PLESSEY PROFESSIONAL CONTROLS



Plessey provides the widest selection of Professional class carbon and wire-wound resistive controls of both commercial and DEF Qualification standard.

The range offers miniature potentiometers rated upwards from 50mW to power rheostats of 500W, together with a choice of resistances, tapers, shafts, mounting arrangements, ganged and dual types and specials to suit customers' specifications. Ganged potentiometers with track matching to within 1.6db. are available for stereophonic equipment, test instruments and other applications.

Potentiometers employ a hot moulded carbon track construction giving extremely low electrical noise throughout a long, trouble-free life. Life expectancy is in the order of 9 million cycles of rotation with a resistance change of no greater than 1%.

Plessey potentiometer tracks consist of a phenolic moulding loaded with carefully controlled proportions of conducting carbon filler providing superior power dissipation and temperature coefficient characteristics compared to carbon film types.

A standardised range is available ex stock. Literature is available on request to the Professional Components Division.

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COMPATIBILITY

Continued

The result may be excessive cone movement at the very low rumble frequency. This will be heard in two ways: either as harmonics of the rumble frequency or as modulation of the higher-frequency program material in the woofer's frequency range. Both of these effects are possible, even if the speaker has a limited low-bass response. Indeed, it is more likely to occur when the woofer can't respond to the usual rumble frequencies.

If the grille cloth of a given speaker is removable, one can easily check for the presence of subsonic rumble. Watch the woofer cone when the pickup is placed on a record with the amplifier set at fairly high volume. There may be a visible back-and-forth movement of the cone that does not correspond to the bass in the program material.

The allowable limits of this movement depend on the speaker design, but, in most cases, a peak-to-peak displacement of more than ¼ inch can be considered potentially troublesome.

Not all low-frequency disturbances are caused by the turntable mechanism. Record warps can introduce large subsonic signals that are recognisable by their periodicity (once per record revolution). Turntable rumble, on the other hand, is constant throughout the rotation of the record. The effect on the system is the same, whatever the cause.

A very desirable feature of some amplifiers is an input filter that rolls off their response below 20Hz. Although this may offend some sensitive audiophiles, it is the most effective method of treating the problem at minimum cost. "Rumble filters" can do the same thing, but most of them will also remove too much of the low-frequency signals in the program.

Amplifier power stages generally have a limited power capability at subsonic frequencies, and can also be overdriven by rumble of this type. It is less common than speaker overload, but it must be considered as a possibility.

All in all, the best way to avoid subsonic rumble problems is to match the quality levels of your components. A low-price turntable should not be used with a de luxe, high-power amplifier and speakers with extended bass response.

Acoustic feedback is a common and frequently misdiagnosed compatibility problem. Feedback is heard as a loud rumble or low-requency "howl" through the speakers when playing a record at high volume levels. It disappears when the pickup is lifted from the record. Its effects can be apparent at much lower listening levels as a "heaviness" or muddy quality in the bass region, plus a general loss of overall "tightness." Feedback can also greatly exaggerate turntable rumble.

Acoustic feedback is the result of a physical vibration of the record-player system by the low-frequency energy from the speakers. The speaker energy may reach the player directly through the air or via the connecting cabinet, floor, or other house structural members.

There would scarcely be a problem if the record-player assembly did not have a resonance or resonances within the low-frequency range of the speaker. This resonance situation is very complex and unpredictable since a cartridge—arm resonance, near the audible range (about 20Hz, for example) can aggravate the condition, but the turntable and its mounting base may have their own easily triggered resonances.

The most successful treatment is preventive: isolate the record-playing components from the speakers, and never place the speakers in the cabinet that houses the record player. This can be — and is — done in mass-produced console systems only because the speakers' low-frequency response is deliberately sacrificed and/or special steps have been taken to isolate the turntable assembly and/or speaker systems mechanically from each other.

It may be possible to cure an existing acoustic feedback condition by mounting the turntable on isolating springs or resilient pads. Sometimes adding more mass to the turntable mounting base will move its resonance to a safely low frequency. Many turntables contain their own isolating mounts, making them more or less immune to feedback. But each case is unique, and requires its own cut-and-try solution.

As is the case with rumble, restricting the system's low-frequency response will also cure acoustic feedback. Often a cut-off below 40Hz will eliminate the feedback problem without significantly affecting program quality. Generally, acoustic feedback occurs only when the speakers can deliver a useful output at frequencies below 35 to 40Hz, and many (especially smaller, low-price speakers) cannot.

(To be continued)

A new AIWA cassette recorder type TP-770 has provision to vary the tape speed: slower for detailed listening; faster to skip over unimportant material. The microphone is built in. Details from Goldring Engineering (A'Asia) Pty Ltd, 26 Ricketty St, Mascot NSW 2020.

News Highlights

Computerised inventory for nuclear plant

A revolutionary new computerised manufacturing system, capable of simultaneously tracking and recording the manufacturing history of individual containers of uranium fuel as they undergo processing, has been installed at General Electric's Nuclear Fuel Department plant in Wilmington, North Carolina. The system was designed by computer experts at the General Electric Research and Development Centre, Schenectady, New York, and manufacturing personnel at the Wilmington plant where the system is now in operation.

Designated MICS (for Manufacturing Information and Control System), the new system plays a crucial role in meeting the US Atomic Energy Commission's standards for accountability of nuclear materials. In addition, an accurate inventory system saves time, money and energy, thereby improving the economics of nuclear fuel manufacture.

To ensure system reliability, major items of equipment used in the MICS system are duplicated. The equipment used includes two computers, two 12-million-character random access memory discs, two magnetic tape recorders, and 79 computer terminals of various types located throughout the factory. 69 of these terminals are used by plant employees during the manufacturing process, in which uranium is processed into fuel rods for atomic power stations.

The other ten terminals in the system are inquiry-response terminals used by plant managers. These terminals can print out a variety of reports at the press of a button, including a listing of the uranium containers within a particular area. Any container within the plant area can, therefore, be located within a matter of seconds.

MICS also plays a vital role in maintaining the plant's quality assurance system. It records the results of tests performed on uranium at different points in the manufacturing process, and maintains a series of "release gates" through which no material may pass until it has satisfied all quality control standards.

An important part of MICS' quality assurance responsibilities is prevention of container misidentification. Attached to each container is a code that includes the enrichment of the uranium, the weight of the container, the material type, and other factors. In addition, MICS keeps track of routine sampling tests, and prevents further processing of a container until the test results have been entered into the system.

To enter a material transaction into the MICS system, the process operator inserts a computer identification card into the terminial slot at his work station. A second computer card, identifying the uranium container he is about to process, is placed into another slot. In response, the computer lights up a series of instruction signs on the terminal, leading the operator through the steps necessary to record the transaction.

If, at any stage, the information fails to satisfy the computer, an error warning alerts the terminal operator, and he is asked to enter the information again. If the information still fails to satisfy the computer, the operator is instructed to call his foreman, and an error message is printed out on a terminal in the control room.

New atomic clock standard

The fifth generation of atomic standards for frequency and time interval measurements has been completed at the US National Bureau of Standards (NBS) in Boulder, Colorado.

The new standard, NBS-5, incorporates many new features for improved stability and accuracy, and shows promise of achieving an accuracy of at least one part in 10 million million.

NBS-5 takes advantage of recent advances in cesium-beam technology. These include completely re-designed electronic systems which accurately lock the output frequency of a high-quality quartz crystal oscillator to the cesium transition frequency. NBS-5 has a completely re-designed beam tube with cesium ovens and detectors at both ends so that the beam direction can be reversed. This allows errors caused by small asymmetries in the microwave cavity to be detected on alternate runs. The cavity has been constructed and adjusted to minimise the phase difference between the two ends. Improved, too, are the permanent magnets forming the "optical" system which deflects the cesium beam and focuses it on the detector.

In a cesium-beam device, the frequency information contained in the cesium atoms is extracted by interrogating them with microwaves. If the injected microwaves match the natural cesium transition frequency, the atoms invert their magnetic orientation as they travel down an evacuated tube. Magnetic fields deflect the inverted atoms toward a detector. The detector controls the microwave frequency (derived from a quartz crystal oscillator) by means of a servo system. If the atoms miss the detector, the frequency is automatically corrected until a maximum number of atoms hit the detector. Thus, the cesium resonance frequency controls the frequency of the quartz crystal oscillator.

In actual practice the NBS-5 standard does not drive a clock; instead, it is used periodically to calibrate the frequencies of an ensemble of smaller cesium-beam atomic clocks that run continuously. The reading of this ensemble is then computed, suitably averaged, and designated the Atomic Time Scale of NBS.

Renewed interest in cable television

The recent resurgence of interest in cable television in Australia is seen as good news for the Australian electronics industry, which is currently preparing for the advent of colour television following the recently announced tariff reductions.

Amalgamated Wireless (Australasia) Limited already has a subsidiary cable company, AWA Rediffusion Pty Ltd, which has been operating in Australia since 1971. AWA Rediffusion Pty Ltd is a joint venture between AWA and Rediffusion International Limited of Great Britain.

Pilot cable TV systems are tentatively planned for either Tuggeranong or Albury/Wodonga, and should one of these get the go-ahead, it will provide good potential for the local industry to supply the Australian Post Office, or private system operators, with equipment and services for community TV systems from Australian sources.

Commenting on reports of Federal Government interest in cable TV and domestic telecommunications, the general manager of AWA Rediffusion, Mr R. McCallum, said: "We welcome any move which will establish community TV systems, particularly in view of the advent of colour television, and look forward to liaison with Government departments or other organisations to provide Australian services both in the equipment supply, and cable system operation areas."

Mr McCallum indicated that his company's overseas associates were already operating sophisticated dial access systems with 36 channel capacity. He also stressed the need to ensure that cable TV was seen as an extension of broadcast television, and should not be promoted to disadvantage existing TV broadcast stations.

Australian participation in Jupiter encounter

Tidbinbilla deep space communication complex, which is maintained and operated by AWA under a Department of Supply contract, played a major role in the provision of support to the Pioneer 10 Spacecraft during its fly-by of the planet Jupiter.

Launched in March 1972, Pioneer 10 travelled 992 million kilometres during its 21 month journey. It is the first spacecraft to visit Jupiter and, after passing in an arc behind the planet, it is now on a course that will make it the first man-made object to leave the solar system.

During the brief fly-by, a large amount of scientific data was obtained and telemetered back to earth. Mission objectives included measurements of the planet's magnetic field and radiation belts, a detailed analysis of its atmospheric characteristics, and amore accurate determination of the orbits and masses of Jupiter and its moons.

Support at Tidbinbilla was provided by the new 64 metre antenna, which commenced deep space operations in April 1973. This is one of three such antennae belonging to the United States National Aeronautics and Space Administration; the others are located at Goldstone in California and Madrid, Spain.

Cover story: CCTV for education

Educational authorities are finally beginning to recognise the true potential of CCTV as an educational medium, and the number of installations intended for this particular field of application is increasing steadily.

Depicted on the front cover of this month's edition are the recording studios installed in the city of Frankfurt, Germany, for the purpose of recording and transmitting educational televesion programs to schools. The studio was designed by the combined efforts of the education Committee of Frankfurt, the provincial Film and Photograph Archive and the Technical Installations Board, together with Philips Elektronik Industrie GmbH. Operations began at the end of 1971.

The educational TV studio has been designed to meet the following requirements:

- The studio is centrally located in the city to facilitate cable linking with all schools;
- Audio-visual programs of an educational nature may be produced in the studio itself;
- The compiled programes may be transmitted via the network as live broadcasts, or stored for transmission at a later date;
- Educational TV programs broadcast on national networks and by commercial broadcasting organisations may be recorded and re-transmitted, either immediately or at a later date.

Programs taken from other broadcasting stations are usually supplemented with further data, or incorporated into one of the studio's own productions. These programs are then re-transmitted to the schools at pre-determined transmission times.

When the final stage of this project is completed, schools in Frankfurt will be linked to the central studio by a cable network which will make it possible to simultaneously transmit up to ten television programmes to all schools, and also to transmit material, prepared in the schools, back to the central studio.

Remote controlled surveillance aircraft

The prototype of a remote controlled, long range, high altitude aircraft has successfully been completed at the Boeing aircraft plant in Seattle, Washington.

Designated the Compass Cope, the new aircraft was built under an air force contract awarded to Boeing in mid-1971, is powered by a single engine, and incorporates the latest advances in communications technology. It is the first of a new generation of remotely piloted vehicles (RPVs) using advanced digital communications systems to allow a pilot on the ground to fly the aircraft by remote control.

The Compass Cope is designed to carry many different payloads on a wide variety of missions, and is capable of a much longer endurance (without refuelling) than any other aircraft presently in the US Air Force. The new aircraft has a wing span of some 90ft, features an all-fibreglass fuselage which is just over 40ft long, and has a gross take-off weight of approximately 13,000

pounds. The use of a fibreglass fuselage enables the aircraft to be used as a flying radome in which radar and other sending equipment can be installed. Boeing claim that the Compass Cope has the potential to become the US Air Force's high altitude surveillance work-horse for the next decade.

— George E. Toles.

Student radio station at Mitcham

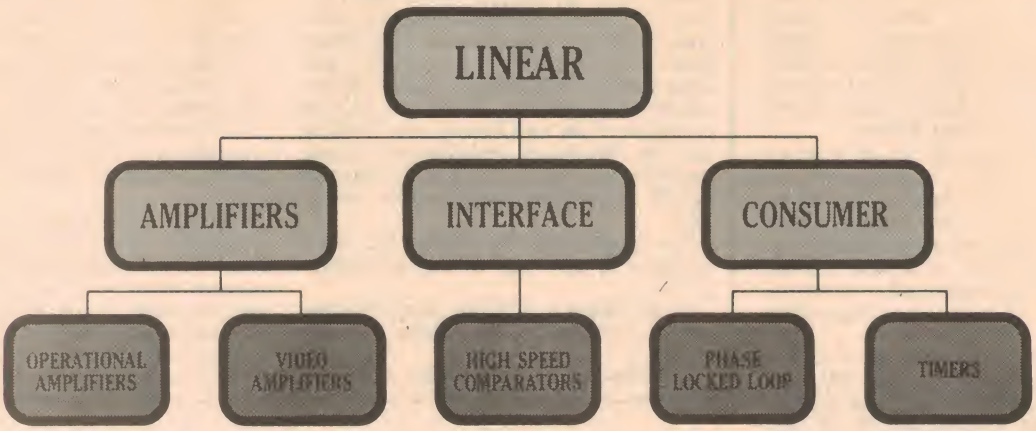
A fully operational broadcast studio, station 3MT, has been constructed by electronics students at Mitcham Technical School, Victoria. The "station" was constructed by fourth formers under the guidance of their instructor, Bill Poppins, and broadcasts its programs via the school PA system to almost 1,000 students during the lunch break each day.

Mixing, fading, muting and similar broadcast techniques are now taken for granted, since the students not only build the equipment and wire the circuits, but also operate them. Simulated outside broadcast facilities can be arranged from "remote" locations.

The project has been so successful that other faculties, such as English and art subjects, are becoming involved. Creative writing projects are now being undertaken and interviews with various interest groups are proposed.

Student Kim Whittles at the microphone. 3MT has a most enthusiastic audience.

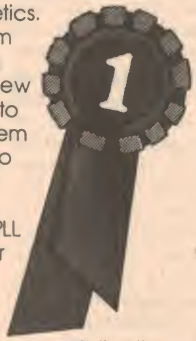
Economy: First Class



SIGNETICS LINEAR. First with phase locked loop! First with the universal IC timer! First with the Schottky-clamped comparator! Plus a solid line of standard-busters in between.

Class tells. In vastly extended design capabilities. In pared down device costs and function consolidation.

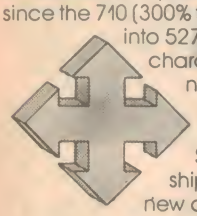
Old shoe linear gets the boot at Signetics. We never leave well enough alone. And from this commitment has come industry-shaking innovations. Spectacular enough to set new technological standards. Practical enough to expand your options without penalizing system design, compatibility or efficiency. But with so much versatility built in, the flexibility of each component reduces circuit count.



Phase Locked Loop. The world's first PLL devices eliminated tuned circuits altogether when Signetics put complete systems on a chip. Operating from dc to 30 MHz, our PLL invention has proved extremely versatile—useful for AM and FM demodulation, frequency multiplication and division, or frequency sensing (tone decoding). With no precision components required. Signetics ships the broadest PLL product line available anywhere: circuits 560, 561, 562, 565, 566, 567 now on the shelves.

555 IC Timer. The world's first standard timer has intrigued countless designers with time control on their hands. Low-cost, easy to use, Signetics 555 functions interchangeably as a resettable time delay, sequencer, power modulator or oscillator. So multi-applicable, you can't help turning creative yourself.

527/529 High Speed Comparator. A real two-in-one breakthrough, still another Signetics first. The fastest, least cantankerous voltage comparator to hit the market when introduced last year. The biggest improvement in comparators since the 710 (300% faster). By incorporating Schottky technology into 527/529, both high speed and precise input characteristics are maximized. Offering users a new generation of sense amplifiers as an alternate application of these devices.



When it comes to industry standards, Signetics linear shapes them up before we ship them out. So much so, they evolve into new circuits—pin-compatible but considerably enhanced. So versatile, you can stock fewer parts yet accomplish a great deal more, while lowering total board costs.

592 Video Amplifier. Primarily applied as a magnetic head preamp for disc file read circuitry. Pin-for-pin with 733, but offering more refined performance and versatility. Proven useful for high frequency bandpass or highpass filtering because no matched passive components are required. So, less parts are needed—both inventory and board work costs go down.

531/536 Op Amps. Salt of the earth, economy-minded op amps for generalized performance requirements. The 536 FET Input Op Amp easily replaces the lower end of the modular op amp market without penalty, and saves up to 50% cost. Low-price 531 High Slew Rate Op Amp is priced under competitive devices, but functions more than adequately over most standard requirements.

540 Power Amplifier. Out-performs common power drivers with extra high speed. This Class AB audio amp on a single chip is economy-priced, but saves still more on unnecessary associated components. Output power limiting delivers total power protection and still allows smaller output transistors: less cooling is required.

Signetics: first class linear that never loses sight of budgetary needs. Far and away the most linear for the money: optimized circuits that let you do more. For less. Volume stocked now at your Signetics distributor.

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NEWS HIGHLIGHTS

Electronic fingerprint recognition

Advanced technology developed by the Calspan Corporation of Buffalo, New York, in designing an automatic fingerprint reader for the FBI is currently being applied to other difficult areas of automatic image processing. Designated "FINDER", the new computerised fingerprint-reading system is capable of processing more than 500,000 resolution elements of a fingerprint in one-half second, making it the fastest digital image processor in the US.

In addition to automatic fingerprint recognition, the new digital image processor has many other possible applications. These include:

- Verification of signatures to reduce losses due to forged cheques and credit cards. In the US, these cost industry thousands of millions of dollars annually.
- Processing of aerial photographs. Some agencies at present using general-purpose computers require hours for this type of processing; processing which FINDER can accomplish in a matter of seconds.
- Development of unmanned personnel identification terminals, where a person can insert his finger into a small unit which would quickly "read" his fingerprint and match its characteristics against those of authorised personnel.

Operation of the FINDER reader starts by loading a standard 8 x 8 inch fingerprint card, showing a set of prints from one person, into a carrier tray. A conveyor

moves the carrier through a light-tight enclosure and sequentially positions each print under a flying-spot scanner. A spot of light, .001 inch in diameter, scans each of the ten prints on the card. Photo-multipliers measure the amount of light reflected from each point on a 16 step scale from black to white. The light spot moves a distance of .002 inch for each new measurement, and all 500,000 measurements, which convert the print to digital form, are completed in one-half second.

— George E. Toles.

Radical new battery gives 3.7 volts

Development of an experimental battery, which produces eight times more electrical energy than a conventional flashlight dry cell and lasts more than twice as long, has been disclosed by GTE Laboratories Inc.,

Called an inorganic lithium battery, the GTE Laboratories' battery has more than twice the shelf life of conventional batteries because its energy source, an inorganic liquid, is used up only when the circuit is closed.

Because of its unique design, the inorganic lithium battery also has an open circuit voltage of 3.7 volts as compared to 1.5 volts for a conventional dry cell. A high degree of voltage stability is another advanced feature of the new battery. For example, a flashlight, operated with the cell, will retain constant light output until the battery is "dead", whilst a radio will retain uniform tone quality throughout the life of the cell.

Conventional batteries produce electric power through the electrochemical interaction of zinc and manganese dioxide electrodes, and a current-conducting element composed of ammonium chloride. The electrodes decompose during the life of such batteries, whether or not they are in use, thereby limiting their shelf life to approximately one year.

In contrast, the current-conducting element of the new GTE Laboratories' battery is composed of inorganic salts in an

This miniature version of the new battery is expected to power a wristwatch for two years.

inorganic solvent, and the energy is produced by an electrochemical decomposition of the inorganic solvent material at the carbon electrode and oxidation of the lithium during the discharge of the cell. The inorganic solvent decomposes only when the circuit is closed, thereby making it possible for the battery to operate effectively for more than two years.

— George E. Toles

Artificial intelligence — some scientists worried

At Stanford University's artificial intelligence laboratory in Palo Alto, a computer has been programmed to simulate the symptoms of a human mentally ill with paranoia. Psychiatrists who interview the computer and human paranoids through a typewriter keyboard say the machine is as convincing a paranoid as the humans.

Through small developments such as this, scientists at a dozen or so laboratories in the United States, Japan, Great Britain and the Soviet Union are probing how to mimic, with machines, the cognitive powers of man. Their purpose is to create an artificial intelligence through use of a computer capable of independent reasoning.

On one hand the rudimentary successes in the laboratory suggest an idyllic society in which sophisticated machines extend each person's potential awareness of all available knowledge. On the other hand looms the potential for a technological hell of Orwellian proportions in which advanced computers are powerful tools used to subvert society. This possibility worries some scientists working in the field of artificial intelligence.

A bank of speech recognition computers, for example, could monitor millions of telephones, signalling a human attendant to pay special attention to telephones where forbidden words were overheard.

Joseph Weizenbaum, an MIT computer scientist, announced last year he would not work on speech recognition and would urge his colleagues and students to follow suit. But speech recognition work continues and Edward Fredkin, another MIT scientist, said that a boycott isn't the solution.

"There is no way to prevent the development of more intelligent machines other than a total disavowal of technology," he said. So, if we can't abandon it, we'd best pursue it intelligently with the interests of mankind at heart."

Research progress on artificial vision

Putting sight back into the eyes of blind people is the ambitious goal of an artificial-vision program at the Institute for Biomedical Engineering, University of Utah.

In a series of tests at the Institute, light patterns, called phosphenes, have been successfully stimulated in blind patients with a pulse generation and control system. The equipment used consists of a Digital Equipment Corporation PDP-11 computer and CRT display to simulate the light sensors, and a PDP-8 computer and stimulation-driver circuitry to actuate electrodes implanted in the patient's brain.

William H. Dobelle, associate director of the project feels that once the proper stimulation parameters, such as pulse width and intensity, are determined, a practical camera and minature data control and storage system should be a relatively straightforward design problem using modern IC technology. The embedded image sensors could be operated by the eye muscles, and the miniature control circuits could simply be worn on the eyeglass frame.

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Videophones: costly, but the gains are great

Although nothing much has been heard of video-telephone systems of late, a recent report from the United States indicates that their introduction may not be all that far away. In this report, the author examines the impact that video-telephone systems are likely to have on society.

by MICHAEL KENWARD

In recent years, the flurry of announcements from telephone companies and public telecommunications authorities describing their various TV telephone / videophone systems has dropped to a trickle. Perhaps the best known of these systems was the Picturephone. Developed by Bell Telephone Laboratories, the Picturephone actually got as far as being test marketed in certain parts of the United States.

In Britain, the Post Office actively pursued its own version of the videophone for some time. The PO is now concentrating on other things and has reduced its videophone activity to a "tickover" level. This should keep the PO up to date with what is going on in this area without pushing it into expensive projects. Instead, the PO is looking to facsimile transmission for immediate growth.

However this temporary mark time for the videophone should not be taken as a sign that the idea will come to nothing. Inevitably, it will sweep into the world's telecommunications systems one day. However, technology will have to reduce the cost of the system and increase its versatility before the public invests the massive amount of money needed to bring the videophone into widespread use.

When the videophone does "arrive" its impact will be enormous; and it will be widespread. Edward Dickson, in association with Raymond Bowers, has looked at the likely impacts of the videophone. His results have recently been published in a report entitled "The Video Telephone, A New Era in Telecommunications — A Preliminary Technology Assessment."

Dickson carried out this project as part of the Program on Science, Technology and Society, Cornell University — he is now with the Stanford Research Institute. He has examined the technology of the videophone and the impacts it might have on various sectors of society. Although essentially an exercise in technology assessment, the report does highlight some of the areas that should perhaps be studied before this new technology begins to make extensive inroads into our telecommunications systems.

The report does not survey the TV telephone of today as the technology that will eventually be sold to the public. Although limited operational videophone systems have been tried out, Dickson believes that the "ultimate" video telephone will offer a wider variety of services.

At the head of the list of attributes of an advanced TV videophone must be the TV telephone we see in today's "primitive" systems. This low resolution system will be accompanied by a "selectable slower scan mode in which animation is sacrificed in favour of high resolution suitable for transmitting textual or prepared graphical material. The display area of the slower scan mode may be four times as large as the area of the smaller animated mode display . . .". This slower system will also be able to feed a printer, turning it into a facsimile transmission machine.

A type of videocassette recorder will also link up with the advanced TV videophone to record "many minutes worth of the animated mode or thousands of frames of the slow scan mode". This will also be linked to an electronic keyboard of some sort, allowing the user to put material straight into a computer, for example.

The impact of the videophone on various sections of the community will be enormous. The first area of influence considered by Dickson is that of the videophone on organisations. Office workers will be the most heavily affected by video telephones, and, according to Dickson, the impact may be sufficient to cause a restructuring of individual organisations.

Computers have already set a decentralisation of office facilities under way. "Many banks, for example, have concluded that computer keypunching, no longer a minor activity, need not be located in the headquarters or branch locations; instead it can be housed in less costly locations outside the central business district and can be served by batch deliveries of information." The video telephone could amplify this trend. "In the future video telephones will greatly alter the manner of doing business, will restructure organisations, and will speed the trend towards decentralisation of office activities."

The secondary impacts of the move away from the centre of town will be immense. For example, what will become of the service industries set up to cater for the needs of the multitude of businessmen and office workers who daily make their way into town? Those small and expensive restaurants will find it increasingly difficult to survive when their expense account customers have moved to the country.

This compact desk videophone system was developed in Japan by the Toshiba company.

Decentralisation will obviously have a significant effect on the transport system. Cities are now served by predominantly radial communcations links. Trains run into and out of town, mostly carrying workers during those periods of torture known as the rush hours. If there is no one there to rush into and out of town, the type of service demanded of the railways, for example, will change.

Many new systems are now being considered to handle projected commuter traffic. It can take ten years or so to take a new transport system from conception to fruition. This ten year lead time between approval and operation indicates that many of the cities planning for new systems similar to BART (the San Francisco Bay Area Rapid Transit system) will find their new transportation systems reaching completion at about the same time that the impact of video telephones is expected to become important.

A new form of transportation system will be needed if workers are not to be forced into their cars in ever greater numbers. Instead of a twice daily radial flow centred on the central business district, the journey to work will be more diffuse and will not occur along heavily travelled corridors.

The possible impact of the video telephone on transport systems brings up a more general problem, according to Dickson. "In the future it will be increasingly important for planners to consider simultaneously the effects of telecommunications and transportation upon urban form. With farsighted planning, it appears possible that video telecommunications and transportation can be used as a positive tool to guide the evolution of metropolitan form."

The TV telephone clearly will also have an impact on business travel other than commuting. According to Dickson, "a study of the air passenger market in the New York region in 1967 found that 57 per cent of all trips by air were for business purposes." How will the video telephone affect this travel? "An economic analysis of the cost to substitute long distance video telephone calls for air travel makes the proposition considerably less attractive, however. At the rates currently projected for inter-city video telephone service, air travel will cost less than a video call that lasts long enough to accomplish the same task."

It is not only business travel that will be influenced by the TV telephone. Several comparatively short video telephone "visits" may substitute for annual visits to distant relatives and could release substantial amounts of vacation time that may in turn be devoted to other leisure time travel.

No technology assessment these days would be complete without some reference to energy and environment. According to the report: "Video telephones may have a favourable nett impact upon the environment. Environmental benefits could accrue mainly from the ability of video telephones to alter the pattern of transportation demand because:

- communication by video telephone requires less energy than communication achieved through physical travel;
- the production of hardware for video telephone systems appears to require less energy and material resources than for transportation facilities;
- video telephone systems create far less air pollution and extraneous noise than transportation modes;
- underground video telephone systems promise to be aesthetically more satisfactory than airports and highways."

A Bell Telephone executive watches a recent videophone transmission from Philadelphia to New York. On the desk is a 12-button "Touch-Tone" set and a control unit.

Dickson breaks the energy costs down into an easily understood comparison. For shorter distances, an energy comparison shows that the energy content in a gallon of gasoline is sufficient either to propel an automobile about 15 miles or to provide 66 hours of conversation via videophone.

As well as these universally significant impacts, the video telephone will also play an important part in education, and in the lives of the physically disabled, as well as in many other important community services.

The TV telephone is, of course, expensive. One estimate puts the cost of today's trial systems at US$35,000 per TV telephone. And while this cost inevitably will plummet as the new technology finally goes into mass production, it is probably reasonable to assume that in a video telephone system with 2 million terminals the average capital investment would be $10,000 per subscriber and the investment in the total system would be $20 billion. According to Dickson, "there is reason to doubt that $20 billion could be raised to finance a video telephone system by 1985."

Society may decide that this money is not worth spending. The large capital investment required to develop and deploy a video telephone system places the decision to encourage or discourage the video telephone in the arena of public policy. Hopefully the public policy analysis will be broadly conceived and consider a wide range of trade-offs not entirely within the traditional scope of the regulation of telecommunications. It is conceivable, for example, that video telephone usage might be encouraged as an alternative to long distance travel in order to conserve energy.

There are other legal and regulatory aspects of the video telephone. What, for example, would Watergate have been like in an era of video telephones? How can privacy be maintained with this new technology? Will the video telephone add a new dimension to the obscene telephone call?

At an international level the major implication is the effect of the video telephone on the US balance of payments. Recent moves within the US have made it possible for the telephone user to attach various devices to his telephone without renting them from the telephone company. In any case, the telephone company may prefer to have their customers buying equipment from other suppliers, thus relieving them of the need to find money to pay for TV telephone terminals. Both moves would encourage foreign suppliers to enter the market.

It is not just the telecommunications regulatory agencies that must take heed of this new technology. As we have seen, the city planner must also carry the TV telephone in the back of his mind when he works on long term plans for his city and its transport services. It may be easier for him to design a system today that will be adaptable in the face of the TV telephone, if it does begin to change life as this report suggests, than to have to start again with new plans in 20 years time. And the telephone companies must themselves carry out their TV telephone R&D programs with their ultimate impact on society in mind.

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The complete range of Optoelectronic devices

Photodiodes

OKI photodiodes are of diffused planar silicon construction, feature high performance and reliability and are suitable for application in computer peripheral equipment, process control, industrial control, photo-meters or any other design requiring light sensitivity.

A 9-bit silicon photodiode array is available which finds application in punched paper tape readers of input machines for computer and NC equipment.

Phototransistors

OKI phototransistors are of planar silicon construction and are highly sensitive devices. They are particularly suitable for use in optical measuring equipment, control devices and other electronic applications.

Solid-state Numeric and Alphanumeric Displays

OKI numeric displays are of GaAsP monolithic or hybrid, 7-segment composition. They are suitable for application in a wide variety of display apparatus. Features include high brightness with small current, numerals 0-9 and decimal point and rugged, vibration-resistant construction.

Typical applications include computer terminals, electronic desk and portable calculators, cameras, electronic wrist watches and various digital measuring instruments.

The alphanumeric display (not illustrated) is a 5 x 7 dot matrix of 36 GaAsP red L.E.D.s.

Light Emitting Diodes

OKI L.E.D.s are available in INFRARED, RED or GREEN versions. A wide range of body styles is available to suit a multitude of applications including solid-state indicators and displays, photo-choppers, photocouplers, photo-switches . . . e.g. punch tape readers, conveyor control, rotation counters, automatic weighing machines, position control and opto-isolators.

Photocouplers

The OKI photocoupler employs GaAs L.E.D.s and Si photo-transistors. Its light source and sensor are optically coupled with no electrical connection. Typical applications include pulse transformers, photoswitches, photorelays, power separation circuits (for analog and digital) and level converting circuits (for potential and impedance).

***Optical Mark Sensor**

(*not illustrated)

OKI manufacture an optical mark sensor which senses by the reflection method, 12-unit signal marks and a timing mark recorded on the paper for OCR use and converts the data into electrical signals.

It is composed of GaAsP L.E.D.s as the light source, planar silicon photodiodes as the sensor and IC preamplifier.

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Armchair space odysseys to Jupiter and return

Whilst space travel to the planets and a landing on one of Jupiter's moons is very much a project of the future, the journey has already been experienced by thousands of visitors to the Reuben H. Fleet Space Theatre and Science Centre in San Diego. This article describes the advanced planetarium currently in operation at the Centre.

Space odysseys projected for the year 2001 are already history to visitors at the new Reuben H. Fleet Space Theatre and Science Centre in San Diego.

Coupling the largest projection dome in the Western hemisphere with Xenon high-intensity arc lamps manufactured by the Eimac Division of Varian Associates, the world's first Space Transit Simulator (STS) takes viewers on a realistic space voyage to Saturn and Jupiter in the year 2350. "Passengers" in the 350-seat wrap-around amphitheatre blast into Earth orbit, dock with a space shuttle, and finally land on one of Jupiter's moons.

"The STS integrates some 10,000 star projections, sun and planet images, traditional and prototype fisheye lenses, 70mm motion pictures, and slide and zoom projectors through computer control," says W. Michael Sullivan, executive director of the Space Theatre and Science Centre. The STS projection dome — 76 feet in diameter — extends to the theatre floor and is tilted at an angle of 25 degrees to give spectators the illusion they're suspended in space. With the earthly frame of reference eliminated, the audience is totally involved in this "voyage to the outer planets."

Designed by Spitz Space Systems of Pennsylvania, the Fleet Theatre has been acclaimed for its major advances in optical engineering and maximizing audience involvement. Described by "Newsweek" magazine as a "brand new type of planetarium that promises to take audience involvement to a new level," the Fleet Theatre uses the light from seven Eimac advanced arc-lamps to project images of stars and planets, and the awesome panoramas of deep space.

The Eimac VIX-150 lamp, which is only two cubic inches in size, delivers a peak beam of 200,000 candlepower, whilst consuming only 150 Watts. Two lamps power the "star-ball", which is the main projector from which some 10,000 stars are displayed. Five additional lamps operate in five special-purpose projectors. These projectors show scenes of five planets and of the moon as it might be seen from any distance in space.

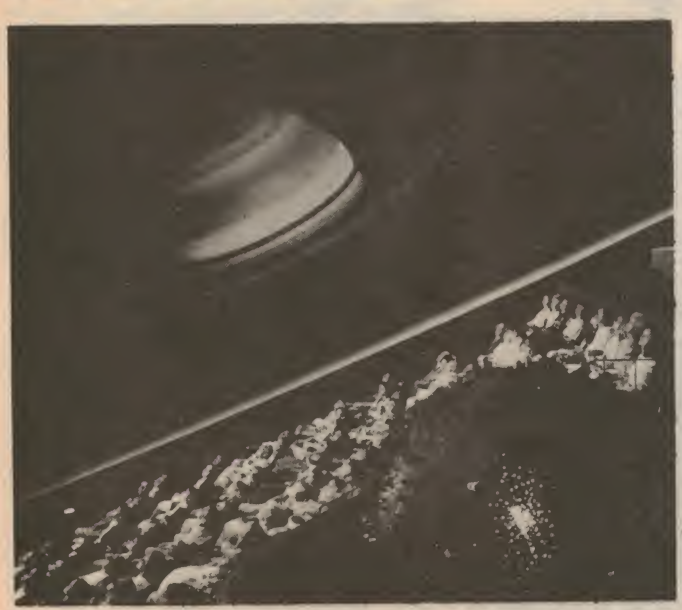
Light from the Eimac lamps is projected through a new type of projector called Omnimax, which covers nearly the entire theatre's dome screen with a single image. Created especially for the Fleet Theatre, Omnimax uses a 70mm fisheye lens and the largest film ever used in motion pictures. "Omnimax presents scenes of unique clarity," Sullivan says, "by covering 80 percent of our projection dome with oversize films in perfect focus."

"In a conventional theatre, it seems you are always seeing things through a window," comments Spitz engineer Dr. Len Skolnick in "Newsweek." "In the Space Theatre, you are part of the picture." A three-dimensional "moving sound" system, including 50 individually controlled under-the-seat speakers, further enhances the audience's involvement. These units supplement 17 large audio units scattered behind the projection dome.

Planetarium designers have given the Fleet Theatre capabilities and accuracy that exceed earlier theatres of the heavens. "Even the brightest celestial objects can be shown at their correct relative sizes," says Louis Tabor, Spitz's chief optical engineer.

To make the size and brilliance of objects independent of one another, the star-ball concentrates and distributes the intense light from the Xenon lamp. The beam is reflected from a tilted concave mirror into a tiny hemisphere at the ball's centre, where light intensity can be as high as 150,000 candlepower. The light then passes out of the star-ball through thousands of optical cells — one cell to project each star image. The light spot at the star-ball's centre is so intense that even the brightest objects can be shown accurately without enlarging them to gain brilliance.

Centre director Michael Sullivan feels that "there will soon be a greater need for projection theatres of exceptional quality, such as this, that provide people with something they can't see on TV or, perhaps, in a lifetime. I think spherical theatres like ours will be the answer."



Presentations in the tilted-floor planetarium maximise audience involvement by creating the illusion of suspension in space.

The "star-ball" accurately shows the size and brightness of even the most distant celestial bodies.

Golden anniversary of radio station WWV

For the past 50 years, one of the most popular radio stations in the United States has been radio station WWV. In spite of its sustained listenership, the station has no music, no commercials, and almost no voice announcements. Its program consists of ticks, beeps, brief voice announcements, and frequency signals; a program that provides one of the most important time and frequency references in the United States.

On March 6, 1923, the US National Bureau of Standards (NBS) started transmitting standard radio frequencies on a regularly announced schedule from radio station WWV. These early broadcasts originated from a laboratory radio station located in the NBS radio building on Connecticut Avenue in Washington, DC, and brought order to a burgeoning radio industry that was threatening to strangle on self interference.

The original WWV transmitter broadcast a number of standard frequencies from 200-545kHz with an accuracy of one part in 10,000 and a transmitted power of 1kW. A wavemeter was used to control the accuracy of the frequencies transmitted of these early broadcasts which were usually dependably received east of the Mississippi, and, on occasions, were reported to have been heard as far away as England and Italy.

Broadcasts were made between the hours of 11 pm and 1.15 am, after commercial stations had left the air, to ensure interference-free transmission. The main aim of these broadcasts was to enable commercial radio station personnel to accurately calibrate their own wavemeters, thus ensuring that these stations were kept to their assigned frequencies.

Today, more than fifty years after its first regularly scheduled broadcasts, WWV occupies a 380-acre site near Fort Collins, Colorado, with its own building, emergency power plant, and antenna field. Completed in 1966, the Fort Collins installation houses eight transmitters, administrative and laboratory facilities.

Broadcasts from the Fort Collins facility are made 24 hours a day on a radiated power of 10kW. The standard frequencies used in these broadcasts range from 100Hz to 25MHz, and are accurate to a few parts in one million million.

In addition to providing services which parallel the original WWV broadcasts (standard frequencies), WWV now provides audio tones of 440Hz and 600Hz for the musical and electrical industries respectively; 1-second time ticks; time-of-day voice announcements; time corrections to maintain proper earth-atomic time relationships; official announcements for the Federal Government; radio-propagation forecasts; geophysical alerts and summaries of selected geophysical events during the past 24-hour period; weather information for the Atlantic area; and time of the year information in minutes, hours, and days.

During its fifty years of operation, station WWV has occupied five sites. The station operated from its first site in Washington, DC, for nearly eight years. In January 1931, frequency transmissions began from a new location in College Park, Maryland, situated northeast of Washington.

After two years at College Park, the transmitter was moved to a 25-acre site at the Experimental Farm of the Department of Agriculture in Beltsville, Maryland, and in January 1943, the station was again moved, this time to a site some 3 miles to the south of the previous site, but still with a Beltsville address.

By this stage, the wavemeter standard had long since been replaced by the tuning fork which, in turn, had now been replaced by three quartz crystals buried in a concrete vault 25 feet below the surface of the ground. This was done to ensure that the crystals were kept in constant temperature and humidity conditions, and resulted in time and frequency signals of unprecedented accuracy for that time.

In the late 1950s, the growing city of Greenbelt encroached on Beltsville and the address of the station site was changed to Greenbelt. The Greenbelt Space Centre, under the control of NASA, was situated in close proximity to the station, and, following expansion plans for the Space Centre, NASA finally became the owner of the station site. By this time, station equipment was obsolete, and the location was some distance from the new NBS time and frequency control centre (the Radio Standards Physics Division) at Boulder, Colorado.

A new site was selected for WWV about 7 miles north of Fort Collins, Colorado, (50 miles from Boulder) where there was no

Photographed in 1923 at the NBS Washington DC facility, the original WWV transmitter was described in a 1924 magazine as a "1kW continuous-wave set of the master-oscillator power-amplifier type designed to operate over a wide range of frequencies."

industrial crowding and the highly conductive soil of an ancient lake bed provided an ideal transmitting site. In addition, this central location provided radio station WWV with a more uniform coverage of the continental regions of the United States.

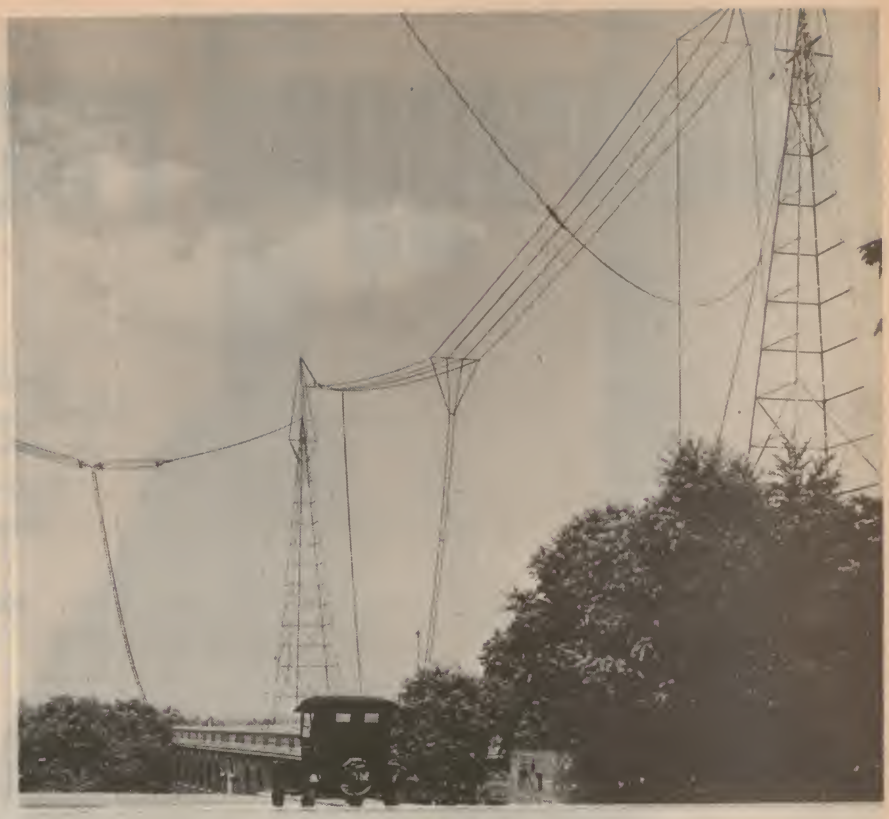
Transmissions from the Fort Collins site, which began at 5 pm on December 1, 1966 (zero hours Greenwich time), resulted in an immediate and dramatic increase in the accuracy of time and frequency transmissions. The reason for this was that, although the atomic clock in Boulder had become the primary standard of frequency and time for NBS in 1957, the new station at Fort Collins was the first to have caesium oscillators at the transmitter site. This enables daily comparisons with the atomic clock.

Throughout its fifty-year history, scheduled broadcasts from radio station WWV have only rarely been interrupted. One interruption occurred on November 6, 1940, when fire broke out at the station (then situated at Beltsville) and almost entirely destroyed it. However, frequency generating equipment was salvaged from the basement of the burned building. An adjacent building, not damaged by fire, contained a small transmitter. By coupling the two, NBS engineers had WWV back on the air on November 11 with no loss of accuracy, although announcements were temporarily made by Morse code.

The most used service of station WWV is time-of-day information. This need holds true not only for navigators, but also for transportation, telephone and broadcasting companies, radio amateurs, and ordinary people who want to know the proper time of day. In response to proper time-of-day demands, WWV now broadcasts Greenwich time voice announcements once each minute. A simple conversion for listeners in every time zone gives each his proper time. Those without shortwave receivers can call by telephone and hear the broadcast at any time, day or night.

Major users tune their receivers to one of six standard carrier frequencies: 2.5, 5, 10, 15, 20, or 25MHz. Identical information is simultaneously broadcast on each frequency. Accurate time and frequency information users include spacecraft-tracking stations, civilian and military aircraft and ships, commercial radio and television broadcasters, seismographers, geologists, astronomers, electric power distributors, manufacturers of musical instruments, and scientific laboratories. In fact, almost all time references within the United States can ultimately be traced to WWV's services.

To supplement the coverage of station WWV, and to ensure coverage of the Pacific Basin area, broadcasts from a sister station, station WWVH, were initiated from Hawaii in 1948. The original low-powered signals from station WWVH were emitted from a site at Kihei on the Island of Maui. In 1971, the station was relocated to the western edge of the Island of Kauai, Hawaii. Transmissions from the new $US1.2 million installation commenced in July 1971, and an immediate 30 per cent increase in overall transmission coverage was noted. The provision of new transmitters with effective radiated power outputs of up to 10kW, unique omni-directional and directional antenna designs, and the addition of a new broadcast frequency were a few of the major improvements made to the new site.



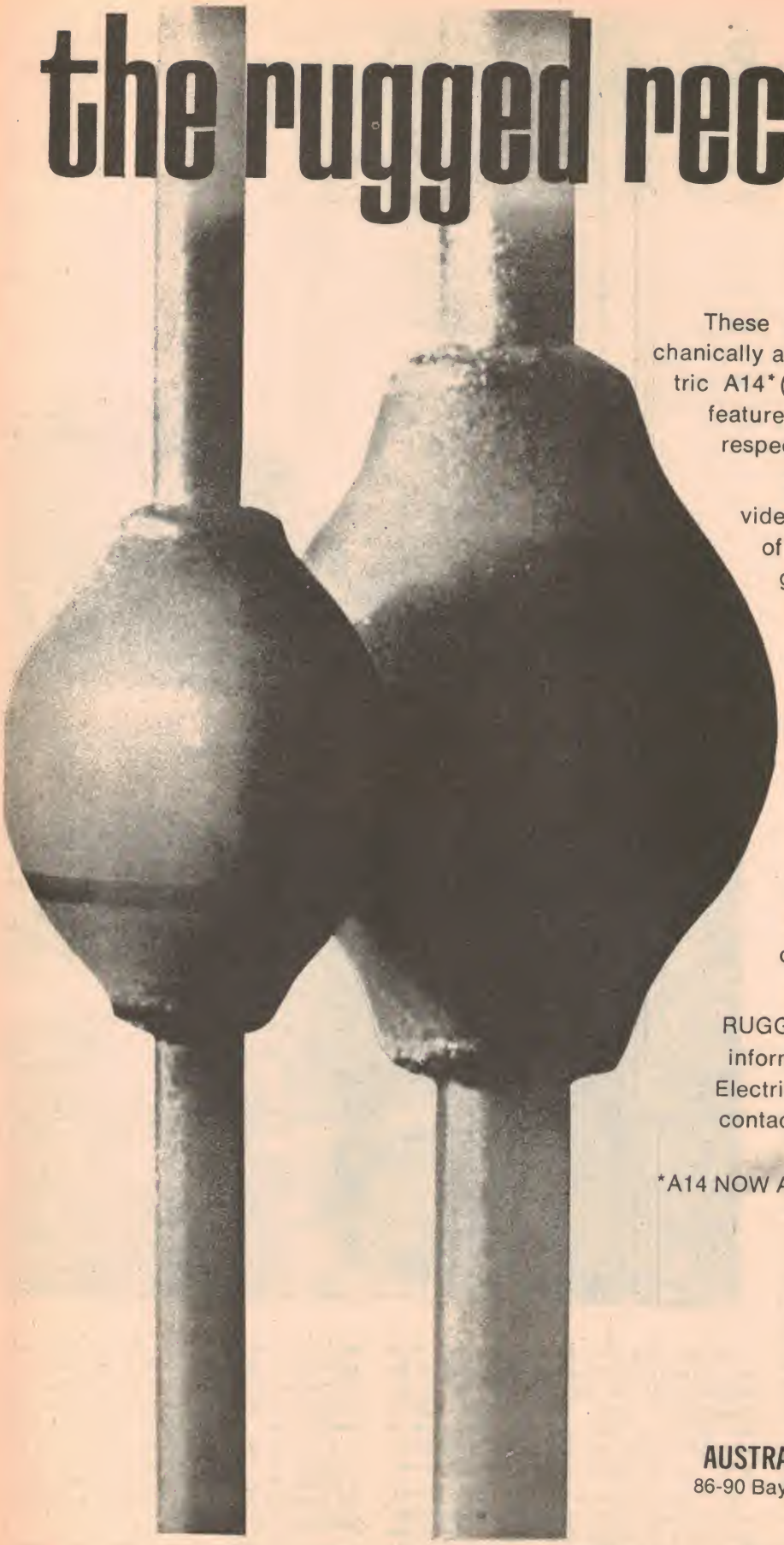
Above are the original transmission antennae used by station WWV in Washington, DC. The bottom view, taken from atop a 400ft transmission tower, shows part of WWV's present day Fort Collins installation.

The services provided by station WWVH are virtually identical to those provided by station WWV on the mainland. It is interesting to note that station WWVH celebrated its 25th year of operation in November 1973, the same year as station WWV celebrated its 50th year of operation.

It is uncertain as to whether station WWV will continue operating for another 50 years. According to James A. Barnes, Chief of the NBS Time and Frequency Division, the National Bureau of Standards is currently engaged in perfecting alternate forms of information dissemination which might make shortwave broadcasts obsolete. However, until alternative methods are perfected, radio station WWV will continue operating, providing a service which has made major contributions to the US space and defence programs, to world-wide transportation and communications, and to a multitude of industrial operations, as well as providing convenient time services to thousands of listeners.

Reprinted from Technical News Bulletin, by courtesy of the National Bureau of Standards.

the rugged rectifiers!



These rectifiers are rugged, both mechanically and electrically. The General Electric A14* (IN5059-62) and A15 (IN5624-27) feature 2.5 and 5 ampere capability respectively, and up to 1000 volts.

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Computerised system reads domestic meters

The quarterly visit of the domestic meter reader may soon become a thing of the past. A new electronic system developed by Kent Meters will enable gas, electricity and water meters to be monitored by a central data processor via the existing telephone network.

by MIKE HALTON

Today, perhaps more than at any previous time, the quarterly visit of the domestic meter reader has become an inconvenience and worry to many a householder. With the ever increasing number of working wives, and the fear to many elderly people of intruders in the guise of local officials, the manual system of reading gas and electricity meters (and, in most countries, water meters) has become a source of irritation to both supplier and consumer alike.

The introduction by Kent Meters in the UK of the TAB-Line system offers the solution to these problems. It allows all domestic meters to be read from a central computer via the existing telephone line network. Result — no visits to your home.

The fact that the consumer may not be a telephone subscriber is of little consequence. Over 2,000 meters can be linked to one telephone line, so that provided there is a telephone in the neighbourhood there is no problem.

The reading time of household meters may now be reduced to a matter of hours rather than weeks, enabling the computer to produce accounts at more frequent intervals. This results in a smaller bill to pay each time.

Basically, the system is monitored by a central data processor, as used at present by most public utilities for consumer billing. The processor is linked directly to the TAB-Line "interrogator" which is installed at each local telephone exchange.

This interrogator, once instructed by the processor, will start to read one or more of the meters within the area served by the telephone exchange.

The interrogator consists of a minicomputer and a local telephone network "interface." The minicomputer accepts the reading instructions from the central processor and later stores the actual meter readings received until such time as the central computer is ready to process this information.

The interface equipment is linked into the local exchange and can "dial" each telephone and communicate with the meter electronics.

At the consumer's end, all that is required is a very small "black box," containing an electronic "memory" and the account number; the memory is linked to each meter on the premises and stores the number of units registered by each meter.

In practice, the interrogator dials the meter and then instructs the master electronics to transmit the data required. This data (the meter reading and account number) is transmitted twice to enable the interrogator to verify it.

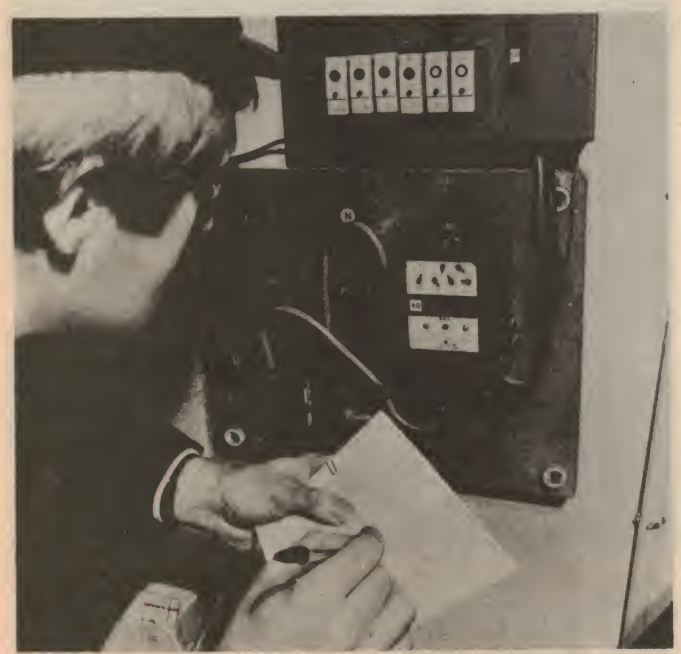
Having satisfied itself that the information is correct, the minicomputer checks the account number against its own file and then accepts the reading into its memory, to await final transmission to the central processor, where it is processed and the consumer billed.

All this takes place in less than a second without inconvenience, interruption or prevention of the subscriber's use of that telephone line. The phone user always retains priority in using the telephone line.

The system has been carefully designed and engineered to ensure that the equipment will work with any of the public telephone services throughout the world. Another important development is that the TAB-Line system requires no external power source beyond that already available through existing telephone networks — a factor which makes the system safe and particularly suited to domestic installations.

Obviously a system such as this cannot be installed overnight, but ultimately the possibility exists for all meterable household services — electricity, gas, water, heating, telephone, television, to be read and billed regularly, probably once a month.

(Courtesy Kent Group News).



The old manual system of reading meters results in large quarterly bills, and prompts fear of intruders in the guise of officials.

The new TAB-line system requires no visits to the home, and results in more frequent meter readings and smaller bills.

Domestic communications satellite system for US

The explosive growth of communications traffic in the United States is beginning to outstrip the facilities offered by conventional communications systems. A domestic communications satellite system program, scheduled to become operational in September 1975, is currently being implemented to meet future short term communications growth requirements.

by GEORGE E. TOLES

Following approval by the Federal Communications Commission, GTE Satellite Corporation, a subsidiary of General Telephone and Electronics Corporation, has implemented a program to establish a domestic communications satellite system in the United States.

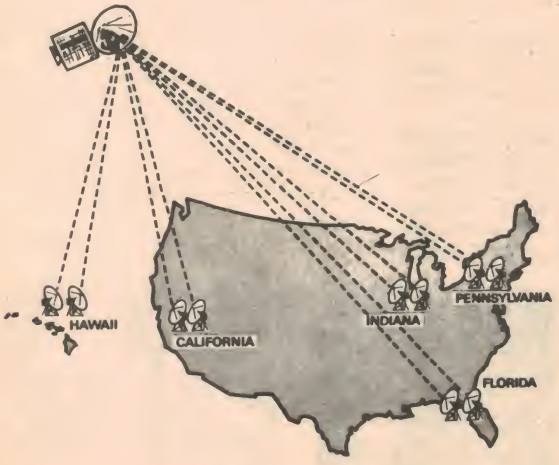
Leslie H. Warner, Chairman and Chief Executive Officer of GTE, said the multipurpose satellite system is scheduled to become operational in September 1975. It will be capable of handling all types of commercial communications traffic, including telephone calls, telegraph, facsimile, high-speed data, and both colour and black and white television signals.

The system will include earth stations in California, Florida, Hawaii, Indiana and Pennsylvania which will be interconnected by means of a satellite 22,300 miles over the equator. The total gross investment for the system is estimated at more than $US52-million.

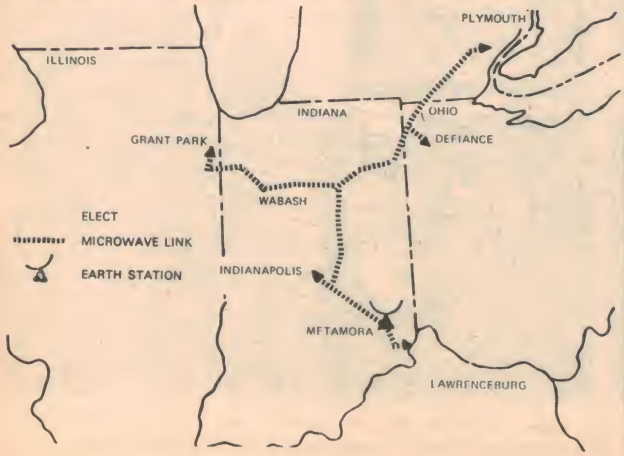
Each of the system's five earth stations will have two matching dish-shaped antennas 98 feet in diameter. The stations will be interconnected through 10 transponders (radio-frequency channels) leased in a 12-channel satellite provided by National Satellite Services Inc, a subsidiary of Hughes Aircraft Company.

The 10 leased channels will provide the system with a total capacity of either 12,000 one-way voice-grade circuits, 10 television circuits, or various combinations of the two circuit types. "Back-up" channels will also be available on a second 12-channel satellite to ensure system reliability. The second "spare" satellite is also intended for short term use during peak-load periods, and during periods when the main satellite is non-operational due to natural phenomena.

The earth stations will be located at Triunfo Pass, California, approximately 40 miles west of Los Angeles; Homosassa, Florida, about 70 miles north of Tampa; Pupukea, Hawaii, approximately 30 miles north of Honolulu; Metamora, Indiana, some 60 miles southeast of Indianapolis, and Indiantown Gap, Pennsylvania, about 40 miles northeast of Harrisburg. The locations were established to serve major geographical areas selected on the basis of



INDIANA EARTH STATION and GROUND TRANSMISSION LINKS



The earth stations, shown in the artist's concept above, will be located at Triunfo, California; Homosassa, Florida; Pupukea, Hawaii; Metamora, Indiana; and Indiantown Gap, Pennsylvania. These locations were selected to serve major geographical areas as shown on the map above, left. At left is a more detailed plan of the Indiana Earth Station.

Each of the system's five earth stations will have two matching 98ft diameter, dish-shaped antennas similar to the one shown above.

current traffic volumes and anticipated future growth.

Ground transmission links of GTE Satellite Corporation will integrate the satellite system with the existing nation-wide communications network through connecting facilities of GTE telephone companies and other telephone companies such as Bell and Independent.

The midwest earth station at Metamora, Indiana, for example, will be linked via a planned 472 mile microwave network of GTE Satellite Corporation with Bell System junction points situated near Indianapolis, Chicago, Detroit, Cincinnati, and other metropolitan areas. Similar microwave and cable systems will link the Triunfo Pass, California, earth station with facilities of General Telephone of California and the Bell System, the Homosassa, Florida, earth station with General Telephone of Florida, the Pupukea, Hawaii, earth station with Hawaiian Telephone, and the Indiantown Gap, Pennsylvania, station with the Bell System.

Appropriate schedules for the production and launching of the two 1,260-pound satellites to be utilised in the system will be developed in co-ordination with National Satellite Services. Resembling drums more than six feet in diameter, the satellites have five-foot parabolic antennas for communicating with the earth stations.

The National Aeronautics and Space Administration will launch the two satellites for National Satellite Services, using Thor Delta rocket boosters. After being placed in orbit, the satellites will have a life expectancy of seven years.

Initially, the FCC has restricted GTE from providing, via satellite, certain services competitive with those of other common carriers. The same restrictions essentially prohibit GTE from offering most of its private-line communications services by satellite for a three-year period after the domestic satellite operations begin. However, according to Mr Leslie Warner, Chairman and Chief Executive Officer of GTE, the company plans to make representations to the FCC to have this latter restriction removed.

Using other tuning units with the July 1973 Homodyne

Minor circuit changes are required to use some types of permeability tuning unit with this design. This note gives the details.

The reader response to the Homodyne Tuner design described in the July 1973 issue was quite dramatic. So dramatic, in fact, that some of the components used became quite difficult to obtain. This was particularly the case with the MC1330P IC, although this device is now in quite good supply.

Probably the only other component which has involved significant supply problems is the permeability tuning unit. Because the unit suggested by the author of the article was made in New Zealand, Australian readers had to find a suitable substitute.

At least a few hundred have apparently purchased a unit which had been advertised by Tudor Radio Pty Ltd, of Stanmore, NSW. This is now out of stock, although the firm is apparently still able to supply a push-button permeability tuner which is electrically very similar.

Although both the original tuning units supplied by Tudor and those now available are capable of being used in the homodyne, there are some basic differences which make necessary some minor circuit modifications.

A close relative of one of our staff members had made the tuner using one of the variable permeability assemblies from Tudor Radio. Although it worked fairly satisfactorily, he was not quite sure that he had done all the right things and asked if we could check it over. As it turned out, in some respects, he had not.

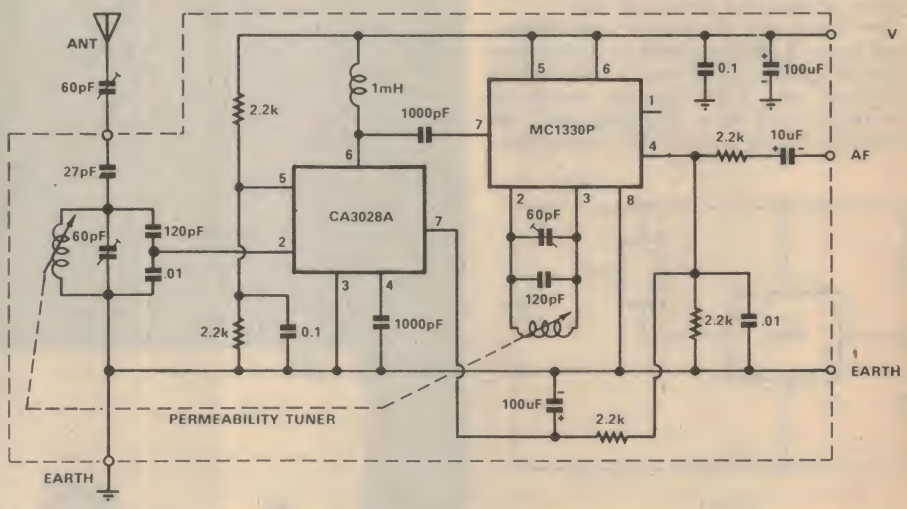
The assembly consists of three coils, located in three corners of a square. Each coil consists of only one winding, and the three are nominally uncoupled. He connected one coil into pins 2 and 3 of the demodulator IC and another coil for the tuned input circuit; the remaining coil was connected between earth and the 1000pF capacitor. It worked, and quite well, despite the accidental coupling, except for problems with correct band coverage, some interference and what later turned out to be some lack of sensitivity.

Of course the unit worked more or less in spite of how it was connected up, and only because there was sufficient coupling between windings to pass the signal from the aerial circuit into the RF amplifier. As the tuning unit was designed for use in a superhet, one coil has been designed for use in the oscillator circuit. This coil is the one which is in the middle — ie, between the other two. We decided to avoid its use altogether and concentrate on the other two.

The coil into pins 2 and 3 was in order but we changed the 180pF capacitor shunting it with one of 120pF. This, with the 60pF Philips trimmer was just right to make the circuit tune the full broadcast band. The same modification was made to the aerial tuned circuit, except that we obviously needed an impedance step-down to match into the RF amplifier, in the absence of a coupling winding. By adding a .01uF capacitor in series with the 120pF, to form a capacitive divider, we were able to achieve a good match. This rendered the .001uF coupling capacitor unnecessary and so it was eliminated.

The modifications thus far resulted in a far more sensitive receiver but it became evident that there may be problems with strong signal effects in some areas. The simple solution to this was to add another 60pF Philips trimmer in series with the aerial terminal. The capacitance can then be adjusted to suit the particular conditions.

The final modified circuit is shown in the diagram. (I.L.P.)



The July 1973 homodyne tuner circuit as modified to suit a permeability tuning unit having neither taps on the tuned windings, nor low impedance secondary windings. A capactive divider is used for impedance matching.

Try your hand at this game of skill:

Buzz-Bar

So you think your co-ordination is pretty good? Here is a little game which you can build to test it. All you have to do is move a small metal loop along a bent wire while touching it as little as possible. If your skill is not up to it, the circuit sounds a buzzer or lights a lamp.

by LEO SIMPSON

Most people tend to snort a little when they see this game. What could be more simple? Its just too trivial! Then they try it. And again. And again. It's certainly not as easy as it looks. And the "course" can be made easy or tortuous — just a few simple bends or maybe a couple of spirals to make it really difficult.

Our version of this game is simple but it can be made more complex. It has a light to tell when you've failed the course, a control to vary the amount of skill required and an on-off switch.

Let's talk about the circuit. Basically, it is a delay timer which adds up the time for which the metal loop is in contact with the bar. If the total time is more than that selected by the skill control, the timer lights a lamp or sounds a buzzer or bell.

The circuit can be built in two forms, using either a Philips OM802 or a Signetics NE555 integrated timer circuit. This should minimise any difficulty the would-be constructor may have obtaining parts for the project. Since the OM802 is the simpler

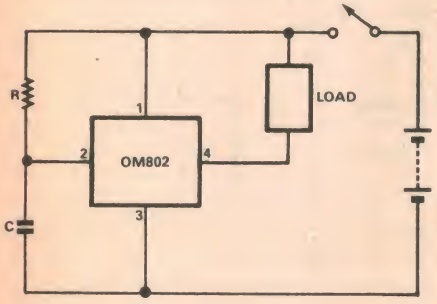


FIG. 1

device and is the one featured in our prototype BuzzBar, let us first describe the operation with this device.

Fig 1 shows the basic circuit of a delay timer using the OM802. There are two connections for the positive and negative supply lines. The load is connected between the positive supply line and pin 4. Initially, the voltage at pin 4 is almost equal to the positive supply so that no current flows in the load. Pin 2 monitors the voltage across the capacitor C which is charged from the positive supply via resistor R.

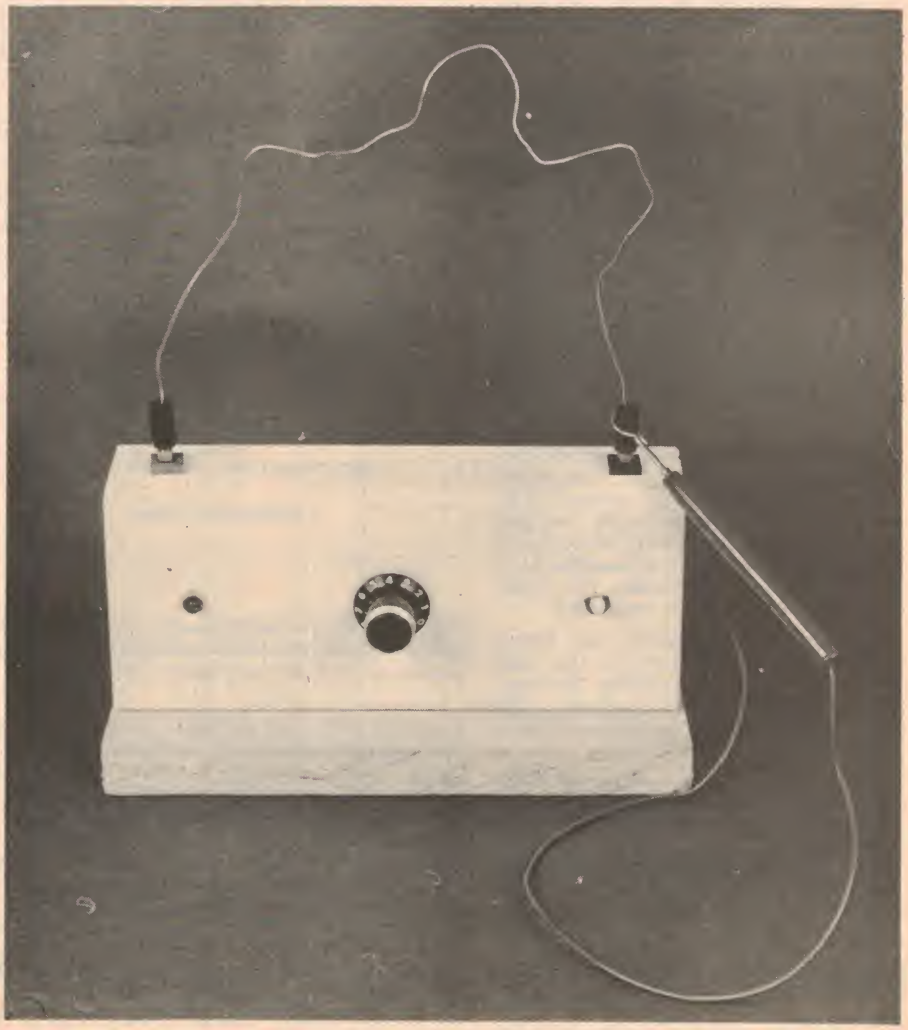
When the voltage across the capacitor rises until it is approximately equal to half the supply voltage, the timer applies almost all the supply voltage to the load, ie, the voltage at pin 4 falls to approximately zero. It stays in this condition until the capacitor is discharged by connecting pin 2 to pin 3.

During the time the capacitor is being charged to half the supply voltage, very little current, less than 10 nano-amps in fact, flows into pin 2. This means that pin 2 of the IC does not cause the capacitor charge to leak away and thus long time delays can be achieved with capacitors of a reasonable size.

Refer now to the complete circuit diagram of Fig 2. The timing capacitor we have used is a 50uF 6VW tantalum capacitor, which has very low leakage. The basic timing resistor is provided by a series combination of a 10k resistor and 100k potentiometer wired as a variable resistor. At the minimum setting of the potentiometer, the maximum time for which the metal loop can be in contact with the buzzbar is approximately 0.4 second. At the maximum setting of the potentiometer, the time is about 4 seconds.

It may be thought that if the player was to move the loop very slowly and carefully along the bar he would have less contact with the buzzbar and thus more chance of traversing its length before the time could give an indication of his failure. But we have thought of that too. Resistor R1 sets the maximum time that can be taken to traverse the length of the buzzbar. With the 270k resistor shown, the maximum traverse time is about 12 seconds.

Thus, there are two requirements placed on the player. He must touch the buzzbar with the loop as little as possible, with a margin for error set by the skill control, and he must traverse the course within a set time as set by R1. But while the maximum traverse time has been set at 12 seconds, each time the metal loop touches the buzzbar the remaining traverse time is correspondingly reduced. So that the more the loop touches the bar, the less time left to complete the course before the light comes on!



Simple, isn't it? Just move the loop from one end to the other without touching the bar.

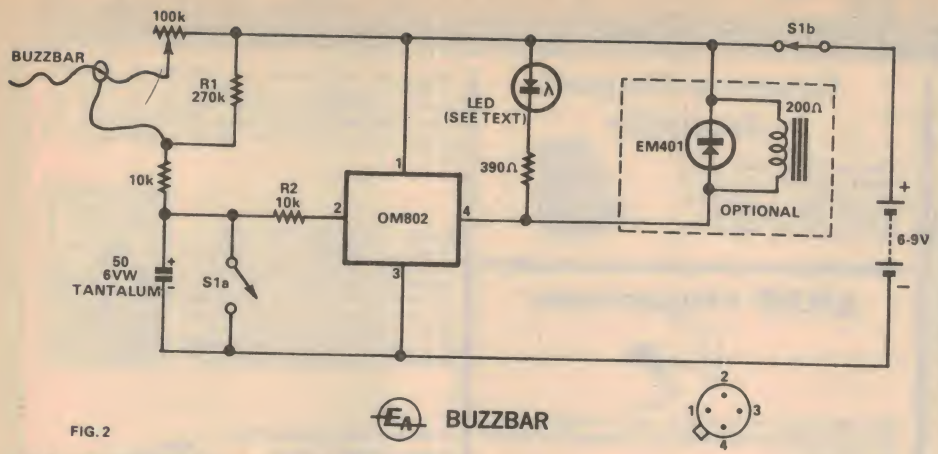


FIG. 2

A 4-pin integrated timer circuit is the heart of the buzzbar.

R1 can be made variable to make the game more flexible or it can be left out so that there is less constraint upon the player. The 100k pot can be replaced by a 100k resistor, and different shaped buzzbars used to challenge the skill of the players. So you have three possible variables: variable skill, variable traverse time and variable buzzbar shape. Who would want more?

R2, the 10k resistor in series with pin 2 of the OM802, is to limit the current to a safe value when the device triggers. But in doing so it does not discharge the capacitor: this must be done by shorting out the timing capacitor with the on-off switch. The on-off switch is a DPDT type (double pole, double throw) with one pole switching the positive supply while the other pole shorts out the capacitor when the unit is turned off. When the unit is turned on, it starts with the capacitor fully discharged and thus the timing is always the same.

The lamp we used to indicate "failure" is a light-emitting diode with a chrome bezel. It was supplied by McMurdo. The 390 ohm resistor in series with the LED limits the LED current to about 20mA which results in a total current drain of the circuit of 25mA. When the LED is off, the current drain of the OM802 is of the order of 150 microamps.

Also shown on the circuit of Fig 2 is a relay shunted by a reverse-biassed diode. The relay is necessary if a bell or buzzer is to be driven by the circuit. We left it out as the sound of a buzzer can be rather irritating, especially to those who are not involved in the game. Another good reason for omitting the buzzer is that their current drain tends to be heavy, requiring a large battery.

If you do decide to use a relay and buzzer, the relay should have a pull-in voltage of 6 volts or so and a coil resistance of 200 ohms or more.

A 60 milliamp incandescent lamp may be substituted for the LED and its limiting resistor, if the constructor has one on hand. The surge rating of the OM802 enables it to withstand the lamp surge without limiting resistors. Note that if a lamp is used, a larger battery than the Eveready 216 we used should be substituted.

A 6V or 9V battery can be used without any changes to the circuit but we chose the miniature 9V battery since it is compact and economical. Note that if the lower voltage is used, no timing inaccuracies occur since the circuit is largely independent of voltage.

Construction of our prototype was kept simple but undoubtedly it could be made simpler still. The circuit is not at all critical as far as layout is concerned. We used a piece of flakeboard measuring 210 x 160 mm as a base, and attached a U-shaped panel of aluminium to it to function as the control panel. All the components are accommodated on a 9-lug length of tagboard. Note that this has a spare pair of lugs to accommodate the diode if the optional relay is used.

Our buzzbar was a length of 16-gauge tinned copper wire soldered to two banana plugs which are then inserted into sockets at the top of the panel. With this arrangement, the bar can be easily changed for more difficult shapes. The loop is also made of tinned copper wire, with the loop being of sufficient diameter to just fit over the insulated portion of the banana plug. We soldered our loop to a meter prod which is then connected by a length of hook-up wire to the appropriate point in the circuit.

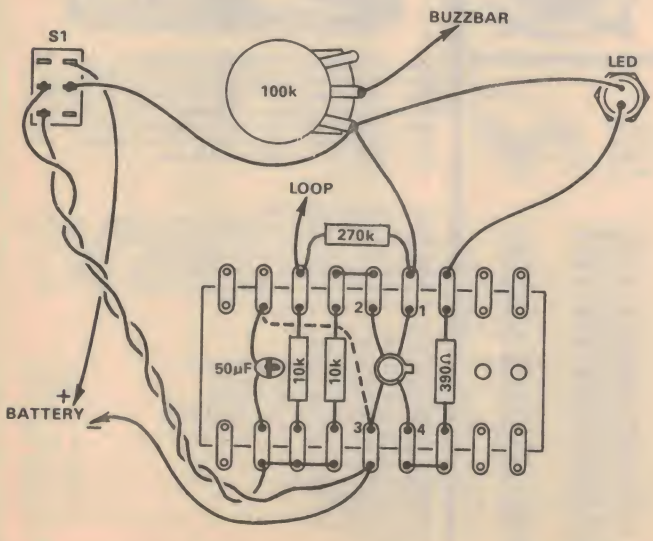
Some readers may feel that the "failure" light could more appropriately be mounted on top of the panel so that it is more visible to the player. It may also be possible to substitute a SPST switch for the type specified and have the probe (loop) shorted to the negative supply line at the start and finish. This could be done using a different type of socket, say an RCA phono socket with the inner connector being the loop connection and the outer connection terminated to the negative supply.

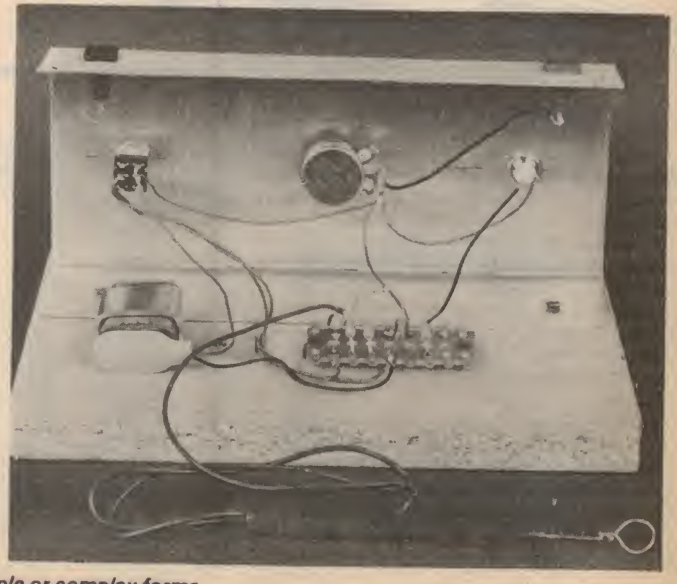
Virtually any light emitting diode can be used in the circuit but the bezel mounting types do simplify the mounting arrangement.

The timing capacitor must be a low leakage tantalum type. The leakage of most conventional electrolytic capacitors will be too high to allow the circuit to function correctly.

As mentioned earlier, the buzzbar can also be made using the Signetics 555 timer integrated circuit. Fig 3 shows the circuit arrangement. We use the same 50uF timing capacitor, but different timing resistors because the 555 trips at two-thirds of the supply voltage rather than half as for the OM802.

The 555 timer is a more complex device than the OM802 and it also functions differently. Initially, no voltage is applied to the load while the timing capacitor charges towards Vcc (the supply voltage). When the capacitor reaches 2/3Vcc the timer trips and applies almost the whole supply voltage





Wiring layout of the Buzzbar is not at all critical and it can be built in simple or complex forms.

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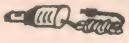

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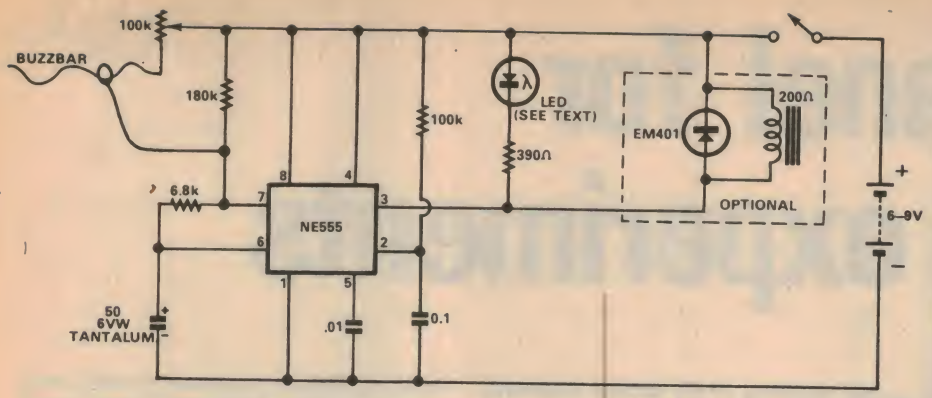


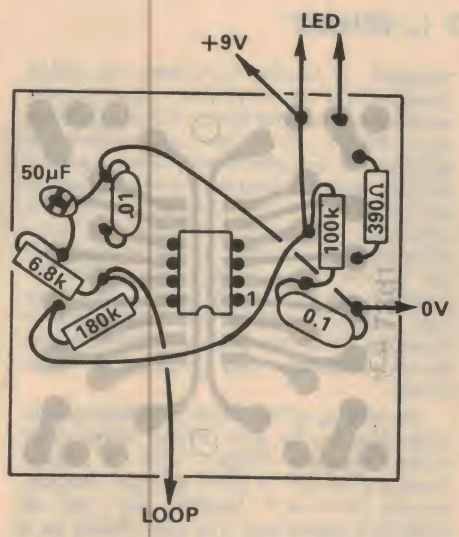
FIG. 3 BUZZBAR (ALTERNATIVE VERSION)

Above is the alternative circuit using the 555 timer IC and below is the wiring diagram.

to the load. It also discharges the timing capacitor via the 6.8k resistor. The circuit then stays in this condition, with voltage applied to the load until a negative trigger pulse is applied to pin 2. One way to do this would be to have a momentary contact push-button short out the capacitor at pin 2, but the same function can be achieved by switching off the supply and then on again.

Whenever the circuit is switched on, a negative pulse is effectively delivered to pin 2 and thus sets the timing cycle in motion. So, as with the OM802, the player switches off, then on, and tries his hardest to move the loop along the length of the bar while touching it as little as possible.

We have used the same load conditions as for the OM802. The 555 can drive the LED and/or the relay. The supply voltage can also be 6 or 9 volts. Note that if an incandescent lamp is used with the 555, in place of the LED, a suitable resistor must be connected in series with it to limit the surge current to 200 milliamps maximum. We recommend the LED version.



When wiring the 555 version you can use either Veroboard with 0.1in conductor spacing or a small printed board with type number 73d1 which we have entitled a DIP board. The DIP board is intended for lashing up circuits using dual in-line package (DIP) integrated circuits. All components are mounted on the copper side of the board. Most kitset suppliers will have the DIP board available, as we have used it in previous projects. If they don't you can always use Veroboard. An accompanying diagram shows the component layout for the DIP board.

Whatever way you build it, we think you'll find it an easy project and an intriguing game!

PARTS LIST

1 baseboard of particleboard, plywood or timber
1 piece of aluminium for control panel
1 calibrated knob
1 100k (lin) potentiometer
1 LED with chrome bezel
1 Eveready 216 9V battery or equivalent
1 snap connector to suit battery
2 banana plugs and sockets
1 battery clip (made from scrap aluminium)
1 390 ohm ½W resistor
1 relay and EM401 silicon diode (optional, if buzzer used)

Extra parts for OM802 version:
1 Philips OM802 integrated circuit
1 50uF 6VW tantalum capacitor
2 x 10k resistors (¼ or ½W)
1 x 270k resistor (¼ or ½W)
1 nine-lug section of miniature tagboard
1 DPDT miniature toggle switch

Alternative parts for NE555 version:
1 Signetics 555 timer integrated circuit
1 50uF 6VW tantalum capacitor
1 x 0.1uF low voltage polyester capacitor
1 x .01uF low voltage ceramic or polyester capacitor
Resistors (¼ or ½W):
1 x 180k, 1 x 100k, 1 x 6.8k
1 DIP printed board, 73d1.
1 SPST toggle switch

MISCELLANEOUS
hook-up wire, screws, spacers for component board, solder.

Note: resistor wattage ratings and capacitor voltage ratings are those used in our prototype. Components with higher ratings may generally be used provided they are physically compatible. Components with lower ratings may also be used in some cases, providing ratings are not exceeded.

Patch panel for op amp experiments

With the uses and applications of IC op-amps growing at an almost alarming rate, it is becoming increasingly desirable to be able to hook up and evaluate a circuit quickly and with minimum effort. In this article the author describes a patch panel, based on a printed wiring board, which is designed for this very purpose.

by CLIFFORD L. MILES*

"Everything in its place" is one of the rules which should figure strongly in the life of the electronics experimenter. To insure those carefully measured reference resistors or other components don't get spread thinly through the "innards" of a range of recently built projects, most of us have to tie them down in some way, yet make them available to use. A patch panel is one way to keep a couple of low cost operational amplifiers handy, together with a range of components so they can be used to make up that meter amplifier, or integrator, or the like just needed at the time.

The design shown here uses a set of 1mm pins inserted into a thicker than average etched circuit board. The same pattern used to hold the pins also provides the labelling. While 1pc precision components can be purchased where it is required to know resistor ratios, many of the values shown on this patch panel need only be 20pc value components which can be upgraded as required. It is also very easy to install components as required, thus slowly building up the board in an almost painless way. Finally, if a few 1pc calibration components are purchased, these together with the op amps themselves can be used to make up the other components to the necessary precision from low-cost 20pc components. Of course, if you are going to put in the effort required to adjust individual components by building up from 20pc series resistors and capacitors, it would be a wise move to get stable cracked carbon resistors, and polystyrene capacitors.

The drilling of the board is at least partly dependent on the pins. Nickel silver (also called German Silver) wire is cheap, readily obtained in short straight lengths, usually 15 cm or 6" bundles, and 1 mm or 0.040 inch diameters. The pins should be a reasonably snug fit into the board. McMurdo (Australia) makes a series of 1 mm pins which may be suitable, but have not been tried.

Drill a short clearance hole 4 or 5 mm deep in a short length of brass rod, say itself 4 mm in diameter, chuck the rod into a drill press, and use the drill press to push the cut nickel-silver pins into the patch panel board. This method will insure that all of the pins are the same height above the panel, and adds considerably to the neatness of the work. If a drill press is not available, try to achieve the same result by hand.

You should plan to have the board manufacturer drill all of the holes to 1 mm or as your required for your pin stock. Then re-drill the other holes to fit your available components. Thus the terminals with the very large pads, marked A, B, E, S, T can be used to either take uninsulated metal terminals, or the Philips type of terminals with insulated knobs, but removable base insulators. No soldering will be required for these. A different type of terminal might be used at "V" and "W". The potentiometers at the bottom of the panel are spaced for the 22 mm diameter Philips miniature carbon pots, but any others which fit will do. These have bushings which require 9/32 inch drills for their clearance holes. The off-on switch at the lower left, and the push switch marked S at the centre, are for ¼" bushing switches. The two positions just below the op amp triangles are the nulling 5K potentiometers, which may be screwdriver adjust types which fit a ¼" panel hole, or another pair of Philips miniature pots which require slightly larger holes.

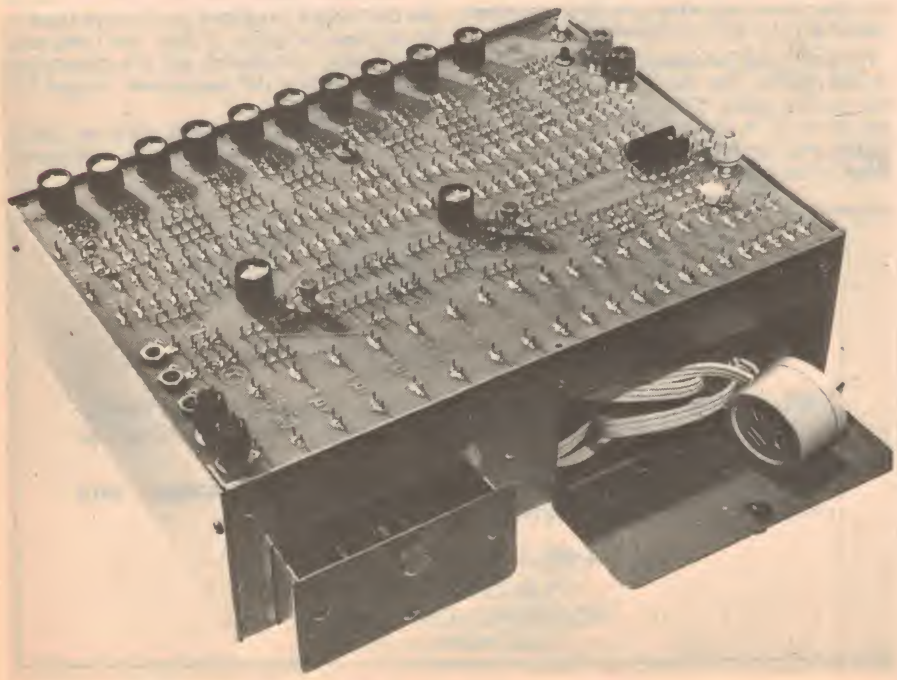
Capacitors, resistors, FET's, and transistors are all slung from their leads beneath the panel. This means that there should be a box for supporting the patch panel, so you might as well plan to make room for the required power supplies (which might be two 12V batteries) cord stowage, a place to put your patch leads, extra components, and so forth.

The few other components which should be mentioned are: (1) the 12V relay, which may be used for some experiments with integrators to make up a voltage to frequency converter with 1pc accuracy.

Item (2) is the pair of sockets for the op amps. You could use Ferranti S8 sockets with the pins bent out, as we did, or Jermyn surface mounting sockets, or just solder the op amps directly to the boards.

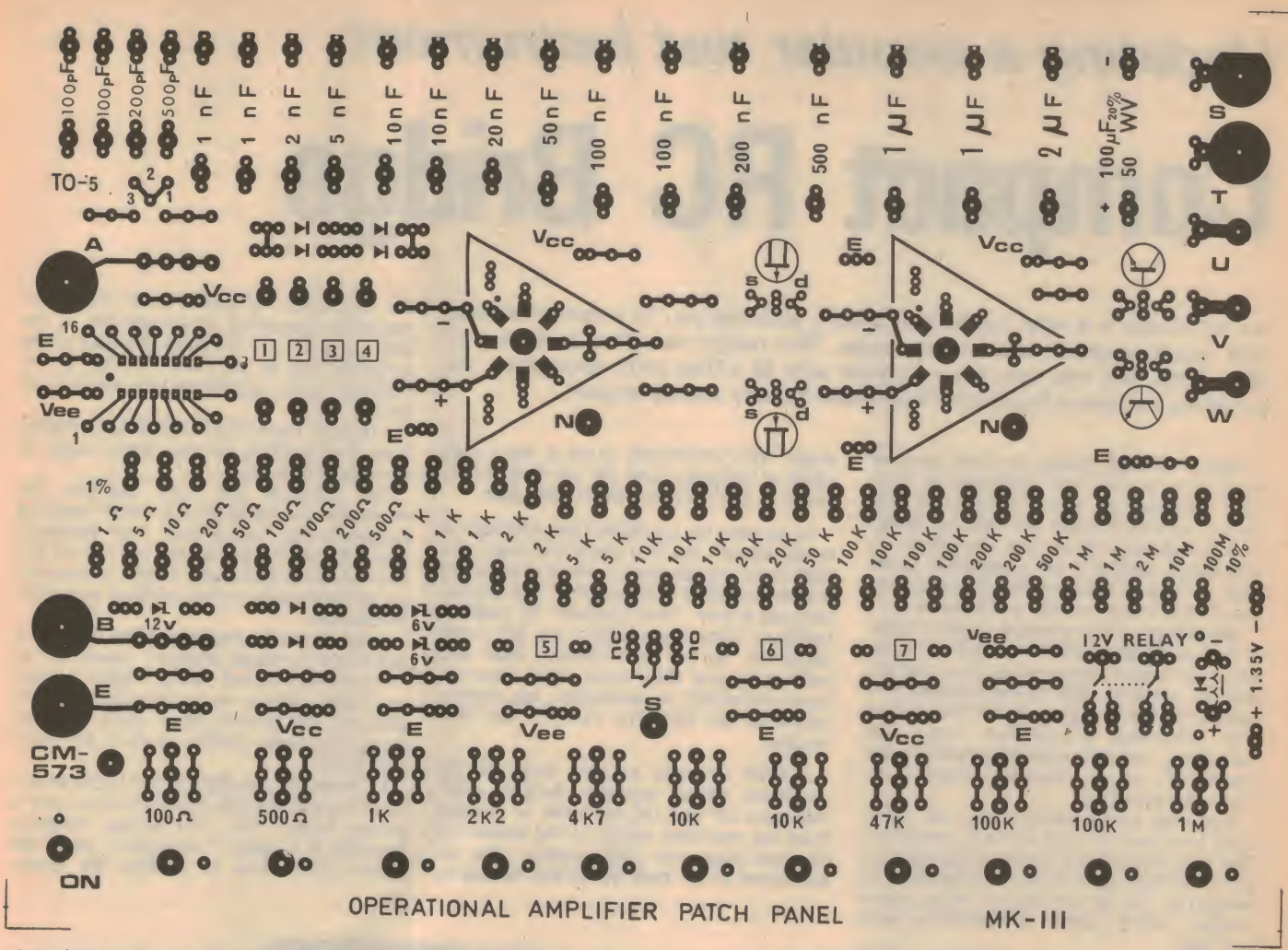
Item (3) would be diodes, and any general purpose silicon diodes would do very well. For the bridge it would be best to select four matched diodes from a batch. This is easily done with an ohmmeter. Any four diodes which have the same apparent forward resistance are OK.

Item (4) would be the zeners. Again, here it would be a good idea to match them carefully to some nominal 6 or 12V rating, then write down what you've measured at



At left is a completed patch panel as constructed by the author.

* Lecturer in Physics, University of Canterbury, Christchurch, New Zealand.



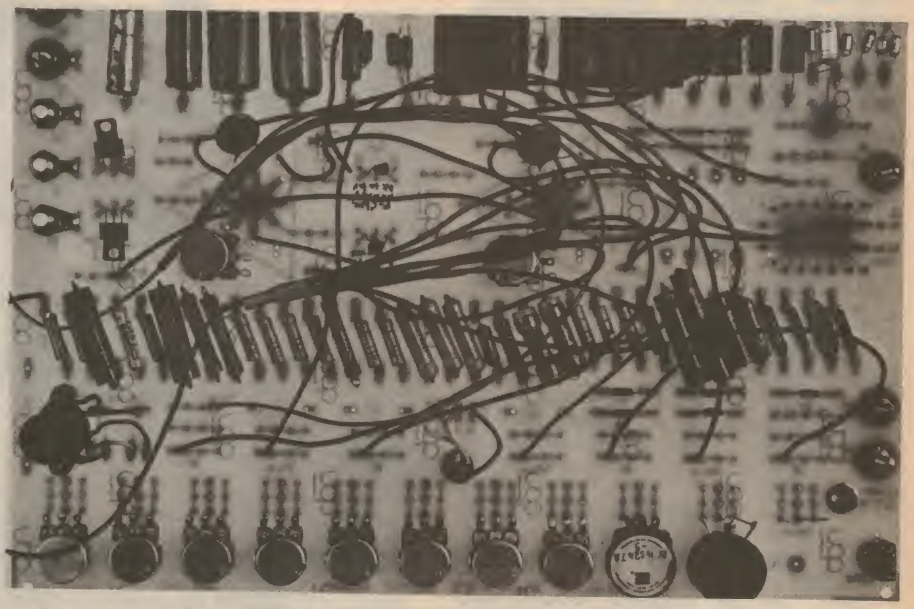
that time and stick it somewhere on the panel. All diodes are mounted below the panel with their leads up through the centre of the rows of three holes. This leaves room for two connector pins for every terminal.

The transistors and JFETS's make up items (5) and (6). Again, selected units as similar as possible, or those which the manufacturer assures you are complementary NPN and PNP, P-channel (top JFET) and N-channel (bottom JFET). The transistors should have betas within about 20pc or better of one another, and be able to handle 200 mA in saturation with voltage ratings at least the full power supply voltage, say 30V for +15V supplies.

The final items of note would be the accessory sockets for the 16-pin DIL package devices and the TO-5 socket. Not all available sockets can be mounted on top of the panel, so make it possible to swing the panel up to stick in what you need into these sockets from below. The spaces which are numbered 1 through 7 in boxes are spare spaces for whatever you wish.

The Patch Panel is designed around the garden-variety 741 fully protected op amp with its own compensation. Any others can be used of course, provided they will fit in the 8 pin TO-99 size can, but you may have to rearrange the wiring for other units. Other types which are plug-in replacements, but with better performance than the 741 would be the Teledyne Semiconductor 141, 241 or 341 series. The commercial temperature range 341 is the cheapest of this series, and no nulling is required. Burr-Brown make a good general purpose op amp, type 1339.

The original printed wiring board pattern (above) has not been reproduced full size. Its dimensions are 28.3cm x 21.6cm. Assembly of the unit onto the coded board is straightforward. The photograph below shows the components mounted in place.



The real heart of such a patch panel is its op amps, but the veins and arteries are the patch cords. You can use the readily available McMurdo patch cords, or those of similar construction made by Limrose Electronics in England. We have made up our own using American Vector cup connectors, their type R23a. Cords of 75, 125, 175 and 250 mm length are required for most layouts, at least 3 of each with a few extra of the shorter lengths. A bit of heat shrinkable tubing makes a nice finish on these connectors.

(Continued on Page 115)

Updating a popular test instrument

Compact RC Bridge

An RC bridge is a very handy instrument, allowing you to measure resistor and capacitor values over a wide range. This design was first presented in May, 1966, but has now been updated with all silicon semi-conductors. Its simplicity and ease of operation have made it a very popular project.

This RC bridge design has been popular ever since it was first published in May, 1966. However we noted recently that the circuit specified some germanium diodes and transistors which are becoming increasingly harder if not impossible to obtain. In view of this, we decided to update the design using modern components.

Simplicity is the keynote of the RC bridge. It has a three-transistor amplifier which drives an edge-reading meter via a voltage-doubler rectifier. The mains frequency is used as the bridge signal source. Ten ranges are provided altogether; four for resistance, four for capacitance and two for connection of an external resistor or capacitor standard.

Accurate measurements can be made from less than one ohm up to 25 megohms. Similarly, capacitors between less than ten picofarads and up to 25 microfarads may be measured. On the two highest capacitance ranges, power factor indication is also provided.

The circuit is basically an AC version of the Wheatstone bridge, which is used to find the ratio of a known resistance to an unknown resistance. When the ratio potentiometer has been adjusted so that its two arms (shown as AB and BC in the Wheatstone bridge diagram) have the same ratio as that of the known resistance to the unknown resistance, there will be no voltage across the null indicator, ie, the null indicator will indicate zero.

The unknown resistance (or capacitance) can then be expressed as the product of the known resistance (or capacitance) and the ratio of the two potentiometer "arms" AB and BC.

As far as resistance measurements are concerned, the bridge voltage source can be DC, but capacitors require an AC signal. For convenience we use an AC source for both — the 50Hz mains.

Note that capacitive reactance is inversely proportional to the capacitance value. This means that the ratio arm scale would need to be in the reverse direction to the resistance ratio scale. In practice, reversal is accomplished by switching, so that only one scale is required.

Refer now to the complete circuit of the RC bridge.

There are four standard resistors and four standard capacitors, all close tolerance units, to give the required ranges. Null indication is provided by a three transistor amplifier driving the meter via a rectifier.

First stage of the amplifier is a common emitter amplifier. Instead of having a collector load resistor, the load of the first stage is provided by a PNP emitter-follower stage. This effectively gives a very high value of collector load for the first stage, which is desirable to obtain high gain.

To prevent the amplifier from loading the bridge circuit, the first transistor is given a high input impedance by means of negative feedback applied to the emitter. The biasing network is also "bootstrapped" by positive feedback from the emitter, via the 0.1uF capacitor. As the gain between base and emitter is less than unity, this does not cause instability or oscillation, but merely increases the effective value of the 220k resistor.

A PNP common emitter stage at the amplifier output provides further gain. Negative AC and DC feedback is coupled from the amplifier output to the emitter of the first stage via a 56k resistor. The AC gain is set by the ratio of the 56k resistor to the resistance in series with the 100uF capacitor connected to the emitter of the first stage Tr1. As it stands, the gain of the amplifier can be varied by the 50k potentiometer from approximately unity to 56 times.

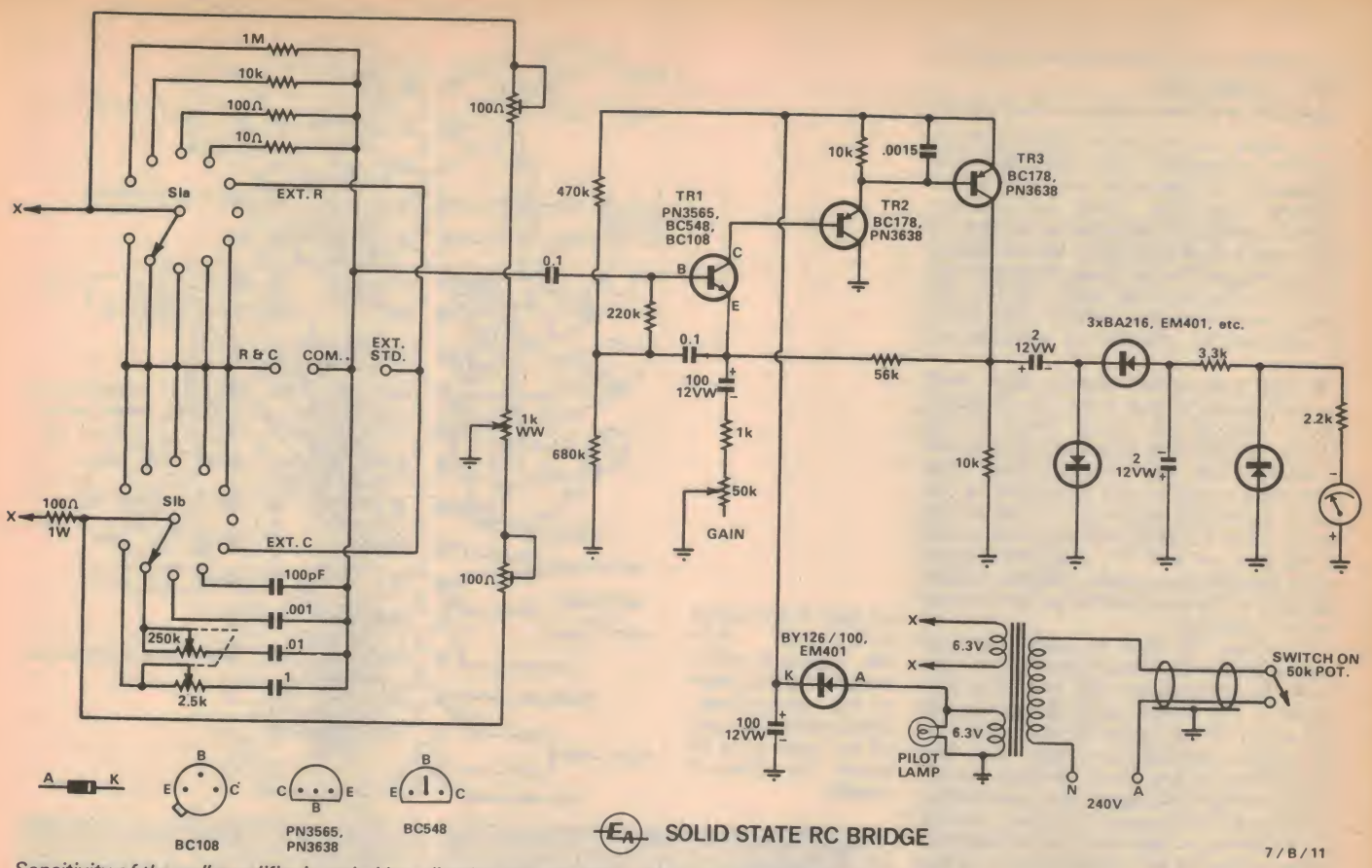
A .0015uF capacitor is connected between base and emitter of the third stage to prevent instability.

One hundred per cent negative DC feedback is assured by the 100uF blocking capacitor just mentioned. This feedback plus the uncritical nature of the circuit allowed us to substitute silicon transistors for the germanium types without any other alterations.

Output from the amplifier is rectified by a half-wave "voltage doubler" consisting of two general purpose silicon diodes. Almost any diode, silicon or germanium, can be pressed into service here since the low signal frequency (50Hz) renders detection uncritical.

DC from the rectifier is fed to the meter circuit which consists of two resistors and a silicon diode. The two series resistors function as a meter "multiplier" while the silicon diode acts to protect the meter

An edge-reading meter provides null indication on this simple-to-build RC Bridge.



SOLID STATE RC BRIDGE

7/B/11

Sensitivity of the null amplifier is varied by adjusting the potentiometer in the negative feedback network.

movement when it is out of null. The two resistors have been selected so that the diode begins to conduct just before the pointer reaches full scale deflection and thus provide an ideal method of meter protection.

One feature of the circuit remains to be discussed and that is the "power factor" potentiometer. This is a ganged control with the 2.5k section in series with the 1uF standard and the 250k section in series with the .01uF standard capacitor.

Power factor measurement in a simple bridge such as this works on the principle that the loss in a capacitor can be represented by a certain value of series resistance and which can be balanced out by a variable resistor in series with the standard capacitor. The control is calibrated on the basis that power factor is the percentage ratio of series resistance to impedance. The potentiometer values specified enable a power factor scale with calibrations up to 60 pc. Note that very few capacitors these days should have power factor of more than a few per cent.

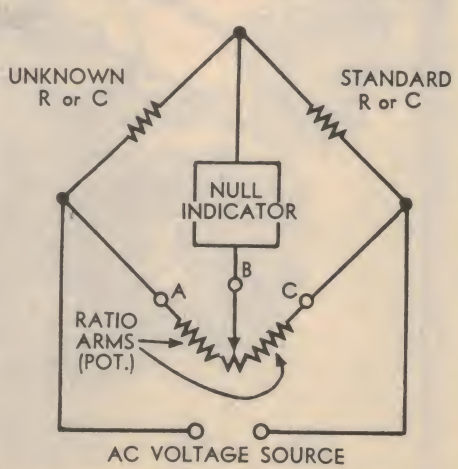
CONSTRUCTION: Assembly of the RC bridge is a straightforward procedure and should take no more than a couple of evenings. It is housed in a standard "Oxford" hammertone steel case measuring 190 x 130 x 100mm, fitted with a "biscuit tin" lid. It was originally supplied by Heating Systems Pty Ltd which now operates under the name Wardrope and Carroll Fabrications Pty Ltd. Cases with all the necessary holes drilled plus an L-shaped bracket should be available as a stock item from most kitset suppliers.

Note that the case we have used is not mandatory and the unit may be housed satisfactorily in any one of a number of attractive cases which are now available.

Most of the components are mounted on a length of tagboard as shown in the photograph. The board is mounted on the front panel of the case with 32mm brass spacers — ours were made up from lengths of 1inch and ¼inch. The wiring layout we have used is not mandatory but can serve as a model to make the job easy.

The meter is mounted in the top right had corner of the front panel. Since the front part of the meter housing is clear it is easily illuminated from behind and below by the pilot lamp which is mounted on an "L" bracket secured by the ratio potentiometer. The 1k ratio potentiometer is a 2-watt Naunton wirewound type which is desirable from the point of linearity and reliability.

Standard resistors and capacitors are the heart of the instrument, and the accuracy of measurement depends largely on the tolerance of the standards and the linearity of the ratio pot just mentioned. But the closer the tolerance of the standards the higher the cost. High stability 1 pc resistors are available at a reasonable price but unless the constructor has a fat wallet he will have to settle for 5 or 10pc tolerance capacitors and perhaps shunt them with smaller capacitors if he has a means of calibrating them.



This diagram illustrates the principle of operation of the RC Bridge.

Power rating of the standard resistors should be ½W or more. Similarly, voltage ratings of the standard capacitors are not at all critical and all likely polyester, polystyrene or polycarbonate capacitors will have more than adequate ratings.

A 100 ohm 1W resistor feeds the bridge circuit from one of the 6.3V windings of the transformer. This resistor provides current limiting when the low resistance (10 ohm) range is selected.

Almost any transformer with two separate 6.3V windings may be pressed into service provided it fits into the space available. We originally used the PF1728 which is made by Ferguson but one of their new low profile transformers, PF 3596 (which has two 6V windings) could also be used. It could be mounted on the rear panel of the case.

Termination of the mains and transformer wiring should be done correctly in order to make the unit completely safe. The mains cord is brought through a grommetted hole in the rear of the case and anchored by a cord clamp. The earth wire is terminated to a solder lug while the mains leads to the switch and transformer are terminated to a four-way insulated terminal block.

Secondary leads from the transformer are terminated to a four-way tagstrip and thence to the major tagboard on the front panel.

R-C BRIDGE

We found that when the 100pF internal standard capacitor was switched into circuit with no capacitor connected to the unknown terminals, there was an appreciable residual capacitance reading at the lower end of the scale. We attributed this to capacitive coupling between the internal wiring and the mains lead to the power switch-cum-gain control. This effect is substantially reduced by shielding as follows:

A length of twin-conductor cable with exterior shield is run from the terminal block carrying the active wires to the switch. The shield is connected to earth via a terminal on the terminal block just mentioned which is also connected to the solder lug for the earth wire. At the switch end, the shield is soldered to the earthy end of the gain pot and to a piece of tinplate approximately 30 x 70mm wrapped around the body of the gain control pot to perform further shielding.

If you are not able to obtain the dual ganged pot for the power factor control you have two alternatives. The first is to substitute a 2.5k linear single potentiometer and settle for the power factor facility on the highest capacitance range only. The second way out is to delete the power factor facility entirely. Similarly, if you wanted to simplify the instrument, the gain control can be left out — just wire the 1k feedback resistor straight to the earthy side of the circuit.

Having completed the wiring, the job of calibration must be undertaken before the instrument is ready for use. What is used for the calibration will no doubt depend on what is available. A high grade type of resistor decade box would be very useful. However, this is not essential and assuming that a scale has been etched on the front panel or a separate scale has been carefully fitted, then this scale can simplify the process considerably. It should only be necessary to check and adjust the extreme ends of the scale.

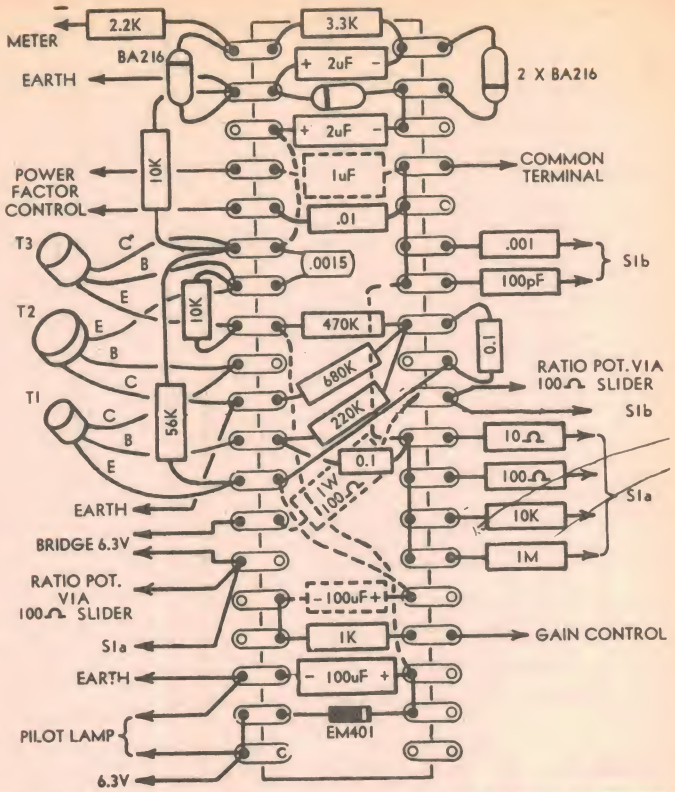
If a decade resistor box is not available, we suggest that you purchase three low tolerance resistors of 10, 100 and 1,000 ohms.

Begin the calibration procedure by first setting the knob with its pointer on the potentiometer spindle, such that the pointer over travels each end of the scale by an equal amount. Then as a further preliminary, set the two 100-ohm slider resistors to about the mid positions.

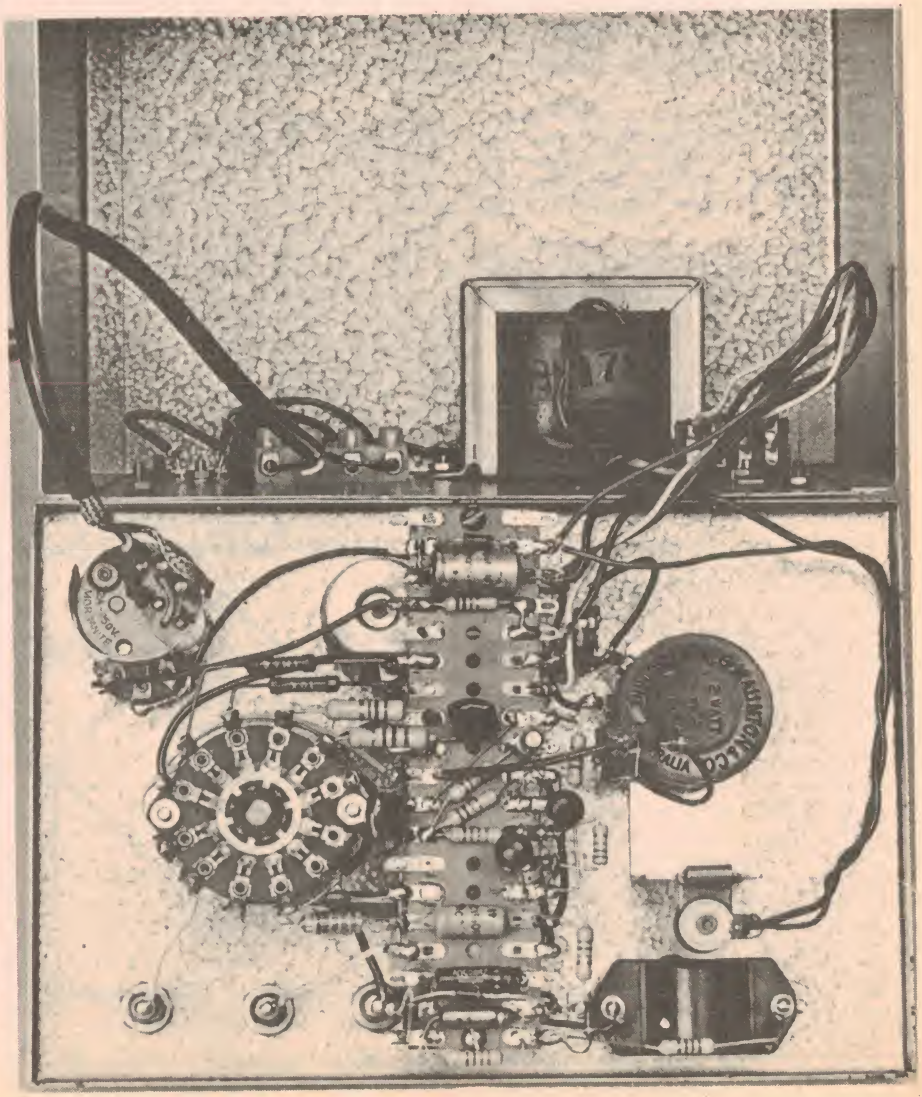
Select the 100 ohm standard on the switch and place the 1,000 ohm resistor across the unknown terminals. Adjust the pointer for a null reading on the meter and corresponding to the clockwise end of the scale. It may be necessary to reduce the gain control but the more gain that can be used, the sharper will be the null and so a more accurate adjustment. If the null position does not correspond precisely with the "10" calibration on the scale, the 100 ohm slide resistor should be adjusted to bring this point right.

Now replace the 1,000 ohm resistor across the unknown terminals with the 10 ohm resistor. Adjust for a null at the other end of the scale. If the null does not correspond with the "0.1" calibration of the scale, then the 100 ohm slide resistor at this end of the potentiometer should be adjusted in a similar manner to the other one.

It will be necessary to re-check the other



At right is the wiring diagram for the tagboard which accommodates most of the components. Below right is a view of the case open to show all internal details.



BRIDGE PARTS LIST

1 case, 190 x 130 x 100mm or similar.
1 front panel
1 handle
1 edge-reading meter, 200uA FSD
1 power transformer with two 6V windings,
Ferguson PF 3596 or equivalent
1 rotary switch, two section; each section 1 pole 11 position.
1 silicon NPN transistor BC548, BC108, PN3565
2 silicon PNP transistors BC178, PN 3638
1 silicon power diode, EM401, BY126 / 100
3 silicon diodes BA100, BA216, EM401

CAPACITORS
2 x 100uF 12VW electrolytic
2 x 2uF 12VW electrolytic
2 x 0.1uF / 25VW ceramic or polyester
1 x .0015 25VW ceramic, polyester or polystyrene
Close tolerance (see text):
1 x 100pF polystryene or mica
1 x .001uF polystryene or polyester
1 x .01uF polyester or polycarbonate
1 x 1uF polyester or polycarbonate
Note: Voltage rating of standard capacitors not critical.

POTENTIOMETERS
1 dual ganged poteniometer; 250k (lin) plus 2.5k (lin)
1 50k (lin) potentiometer with rotary switch
1 1k wirewound Naunton potentiometer
2 100 ohm wirewound slider potentiometers

RESISTORS
(½ W 5pc tolerance unless otherwise specified)
1 x 680k, 1 x 470k, 1 x 220k, 1 x 56k, 2 x 10k, 1 x 3.3k, 1 x 2.2k, 1 x 1k, 1 x 100 ohm 1W.
Close tolerance, preferably 1 pc:
1 x 1M, 1 x 10k, 2 x 1k, 2 x 100 ohm, 2 x 10 ohms.
(This includes the three resistors used in the calibration procedure. See text.)

SUNDRIES
Tagboard with 19 pairs of lugs,
1 pilot lamp socket with push-on clip plus 6.3V lamp
1 four-way tagstrip
1 four-way insulated terminal block
3 insulated terminals, two red, one black
4 rubber feet
4 knobs
2 spacers (see text), power cord, cord clamp, grommet, 3-pin plug, hook-up wire, shielded cable, tinplate, screws, nuts, lockwashers, solder.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower voltage ratings may also be used in some cases, providing the ratings are not exceeded.

end of the scale. More than likely, it will have shifted slightly and will have to be brought into line. Both ends must be checked, back and forth, rather like the alignment of a superhet radio receiver, until both ends are correct.

The centre of the scale should be given a check at this stage. Place the 100 ohm resistor across the unknown terminals and adjust for a null. This should line up on the correct position automatically, assuming that the resistors used as a check are all very close to the correct values and the potentiometer is perfectly linear.

If sufficient error is noted and it is considered that it could be improved, then the pointer may be moved on the potentiometer spindle to correct matters in the centre of the scale. Then the other two resistors will have to be used again to re-set the extreme ends of the scale. This is only a suggestion under these particular circumstances, as it may or may not improve matters. We did not have this problem and it is more than likely that readers will not have any problem here either.

Thus far, we have only calibrated one range of the instrument. However, all other ranges should automatically be correct, within the tolerance limits of the standard resistors and capacitors that have been used. A limited cross check may be made with the 10, 100 and 1,000 ohm resistors used for the initial calibration. By selecting adjacent standard resistors, a further check could be made at least on one end of the scale of the adjacent ranges.

Similar checks could be made on the capacitance ranges, but as we have already mentioned, low tolerance capacitors are not so easy to come by. However, for all practical purposes, capacitance measurements should be quite accurate enough just with the capacitor standards as fitted.

One exception to this could be a further check on the 100pF range. Firstly, check what the residual error is on the low end of the scale and without anything across the unknown terminals. With the method of wiring which we have used, the stray capacitance is fairly low and an expected reading would be about 5pF. This is something we have to live with and small values of capacitance can still be measured, provided the residual reading is subtracted from indicated values.

By way of an example, suppose that an unknown capacitor is measured and the null occurs at a scale reading of 8pF. Subtract the residual of 5pF (or whatever it may be) from this and in this particular case, the actual capacitance is 3pF.

This error should be taken into account in this way up to at least 100pF and even a little higher if desired.

Having ascertained this error, if a capacitor around 100pF of known value is available, then the 100pF standard in the instrument may be checked. Suppose that the checking capacitor is known to be 97pF. Then if the standard is correct the 97pF unit should be read off the scale as 97 +5, which is 102pF. Should the 97pF, unit be checked off the scale as say, 107pF, then the standard is about 5pF low and may be padded up to 100pF by shunting it with a good quality capacitor until correct reading is obtained.

The power factor control will not require checking provided the minimum position is set at zero. When measuring capacitance on the two higher ranges, set the ratio control potentiometer to null. Check and if necessary, adjust the power factor control to give a deeper null.

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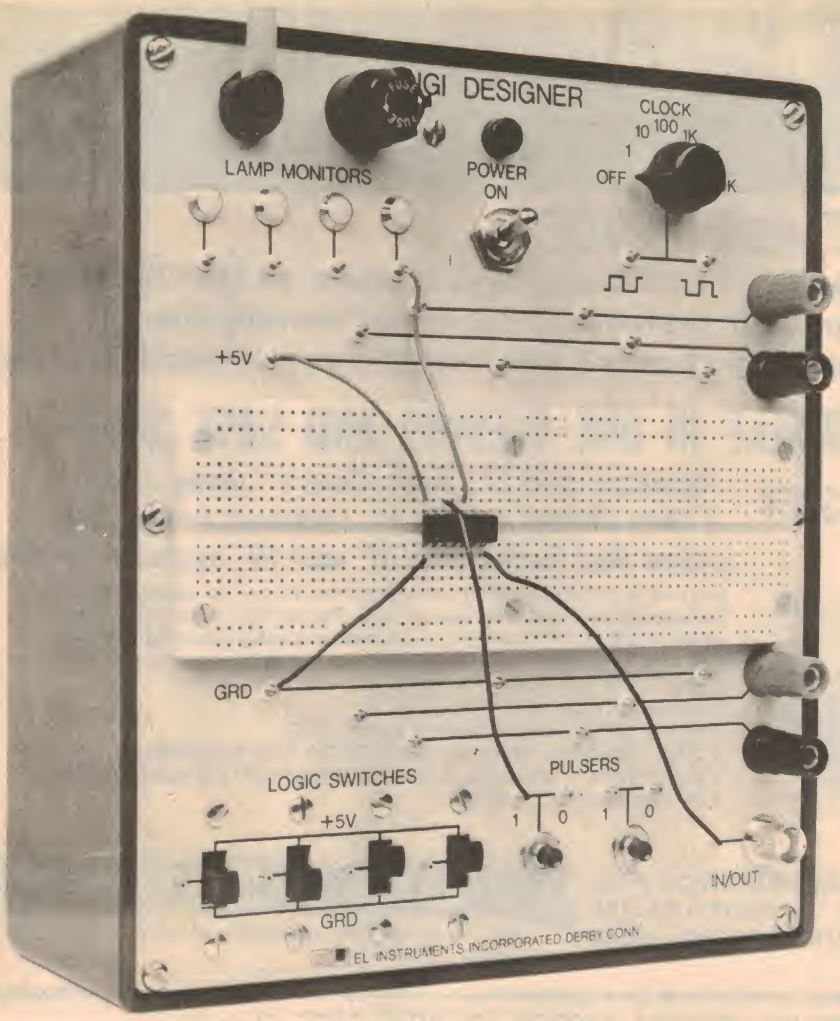


Despite its modest size, the Digi Designer is virtually a complete miniature logic laboratory.

THE DIGI DESIGNER

If you're involved with logic circuit design using digital ICs, you'll find this little unit irresistible. It provides all the basic requirements for fast and easy lash-up of new circuits, yet also doubles as a logic trainer. Designed by EL Instruments Inc, you can either assemble it yourself or buy it built and tested for immediate use.

by JAMIESON ROWE

A breadboarding aid of one sort or another is almost essential when one is attempting to try out even a simple circuit using the usual dual in-line ICs. Without such an aid, progress tends to be painfully slow, and the ICs and other components are likely to be damaged due to repeated lead bending and soldering operations. If you've tried it, you'll know what I mean.

In its most basic form, a digital breadboarding aid may be little more than a scheme which allows the ICs to be plugged into sockets, with their connections brought out to convenient solder pads or terminals. But before it can be put to much use, this basic setup must be supplemented with a power supply, a source of test signals, provision for monitoring logic levels, and a means of setting control signals.

With their Digi Designer, EL Instruments have provided not just a basic breadboard aid, but all of these supplementary facilities as well. Although it measures only 19 x 21.6 x 10.2 cm, the Digi Designer combines a multi-device breadboard socket, a power supply, four logic level monitors with lamps, a dual-polarity clock generator with six switched frequencies, four logic level switches and two dual polarity pushbutton pulsers with bounce suppression.

It thus forms a complete miniature logic laboratory, with which you can easily and quickly lash up — and test — any number of possible circuits and logic configurations. All you need is the ICs and some lengths of hookup wire, and away you go!

Needless to say, it would also be very suitable for use as a logic trainer in schools and colleges. Provided with a few standard gate and flip-flop ICs, it can readily be used to demonstrate virtually all of the basic laws of digital logic.

Heart of the Digi Designer is EL Instruments' SK-10 multiway breadboard socket, which I reviewed in its own right in the October 1972 issue. Based on a precision moulding of high-impact plastic, the socket provides some 328 nickel-silver spring contact clips, grouped to allow multiple connections to IC pins and other devices.

The clips are designed to provide low resistance contact with IC pins, transistor leads, component pigtails and solid-core hookup wire from 22 to 26 gauge. At the same time they require only a relatively low insertion force, which should avoid strain to multi-pin ICs and similar devices.

The fact that ordinary solid-core hookup wire may be used for the interconnections makes the unit very convenient in use. There are no special patchcords to become lost or broken, and leads of any length may be fabricated with a minimum of effort right on the spot.

The socket is mounted centrally on the aluminium front panel of the Digi Designer, with the lamp monitors, clock generator and mains switch, pilot and fuse above it. On the lower part of the panel are the logic switches, the pushbutton pulsers and a coax socket / pin jack combination which may be used either to feed external signals into the unit, or extract signals from it.

Immediately adjacent to the breadboard socket are pin jacks supplying plus 5V and ground, also four pairs of pin jacks connected to screw terminals. The latter again provide a convenient means of interfacing the circuitry with external instruments or other Digi Designers.

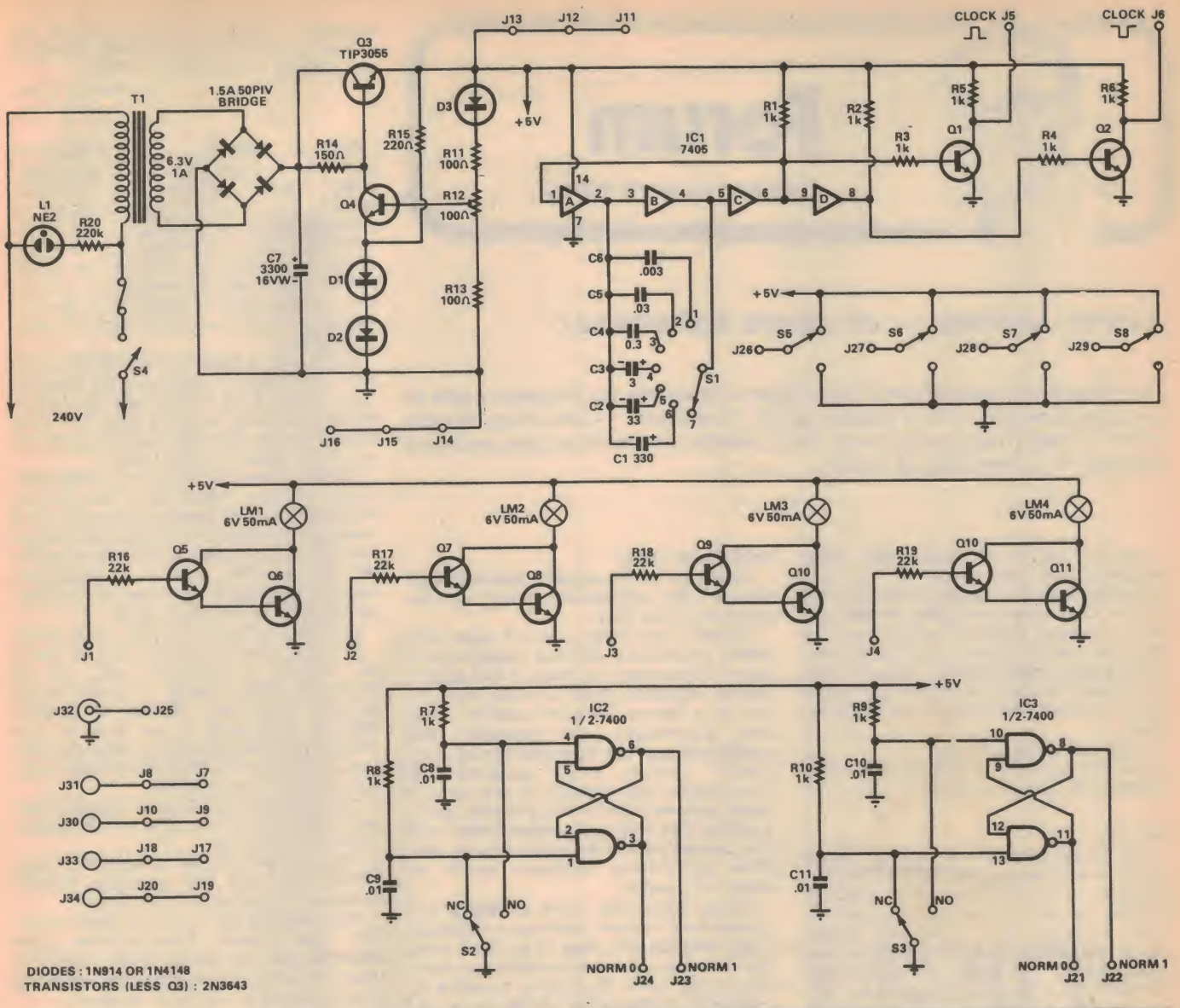
The circuit of the unit reveals a very practical engineering approach to its design. Considering the functions performed, there are surprisingly few parts and the wiring is quite straightforward. In fact the Digi Designer is a good example of the all-too-often forgotten art of "getting the most from the least."

The power supply is a fairly conventional series regulator using a plastic version of the well-known 2N3055. Two normal silicon diodes are used as the reference, with a third in the feedback divider presumably for temperature compensation.

The clock generator uses three of the inverters from a 7405 IC in cascade, with a capacitor across the centre element. The capacitor value is switched to provide the six frequencies: 1, 10 and 100Hz, and 1, 10 and 100kHz. Two discrete transistors are used as output buffer stages, with a fourth inverter from the 7405 used to provide the complementary output.

The lamp indicator circuits are very simple, each comprising only a 6V / 50mA lamp, an input resistor and two general purpose NPN transistors connected in the Darlington configuration.

In contrast with these, the pushbutton

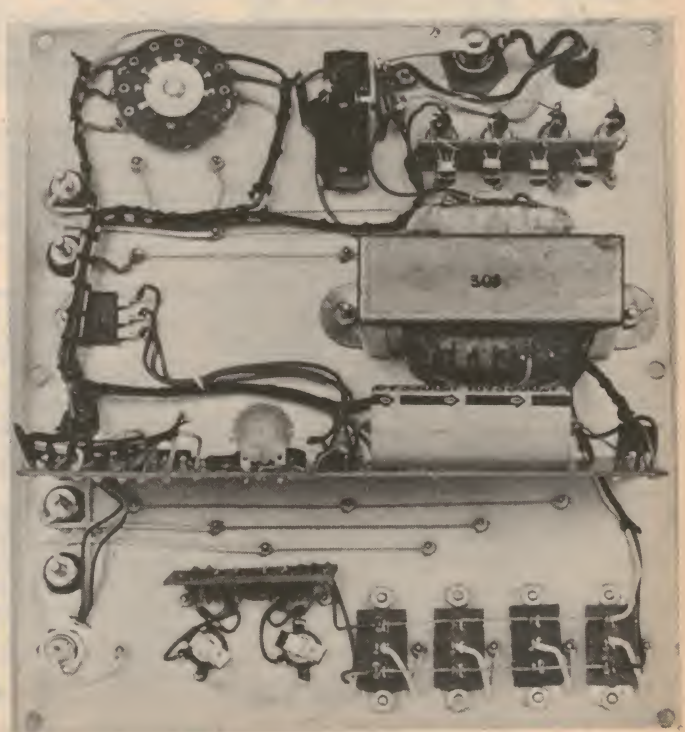


The circuit of the Digi Designer is shown above. While simple and straightforward, it provides all of the required features with no sacrifice in performance. Note the dual polarity clock generator.

pulser circuits seem to reveal a "belt and braces" design philosophy. Each uses two gates from a 7400 IC as a simple R-S flip flop, which is normally quite capable of giving full suppression of button contact bounce. But just to be sure, the designer has also fitted the inputs with R-C integrator circuits. This may not be a case of gilding the lily, though, as the SPDT buttons used are of a rather simple and rudimentary type.

Inside the case, all of the components are mounted on the rear of the front panel — including the power transformer. The power supply and clock generator wiring are on a fairly large printed wiring board, while the lamp drivers and pushbutton circuits are mounted on two much smaller boards. These are supported solely by the wiring, but this should cause no problems in view of their modest size and weight.

Assembled and tested, the Digi Designer costs $102.30 plus tax, while as a kit it is $71.00 plus tax. The SK-10 socket alone costs $22.00 plus tax, by the way. All are from General Electronic Services, at PO Box 579, Crows Nest, NSW 2065.



A view of the rear of the Digi Designer front panel. Note the large printed wiring board used to support the power supply and clock generator wiring, also the two small auxiliary boards.

Forum

Conducted by Neville Williams

Stereo balance — or stereo unbalance?

I am obliged to a reader from Yokine, Western Australia, for the opportunity to deal simultaneously with a number of hifi "chestnuts" — ideas that, like the wheel, persist in being re-invented. Yet, curiously, one tends to gain persistent pleasure in re-disposing of them!

But first let me emphasise that these remarks are not intended to hold correspondents to ridicule. The fact that certain ideas have previously evolved and been discarded, does not detract from the effort of another person who thinks them through quite independently. Ideas become "chestnuts" mainly to people like yours truly, who've been around the scene so long!

Did anyone say too long?

But let's get on with the letter, somewhat abbreviated to save space:

Dear Sir,

I should like to canvas an opinion I have had for some years on the subject of stereo amplifiers. It is the need of a separate amplifier for each channel that I question. . .For instance, in a 2-channel stereo system, the sensitivity and output of the two amplifiers have to be equal, or with less than the minimum difference that the ears can discern. This, I believe, can be a maximum of 3 decibels.

Apart from the advantage that a manually operated balance control provides, in accommodating variable room acoustics, no one has seen the need to devise an automatic balance circuit which would monitor and control the gain of the two amplifiers, based, say, on an error signal derived from the balance of an inaudible high frequency signal fed into each amplifier from a small built-in oscillator. However, this still would not overcome the need for separate channel amplifiers. In any case, in these days of discrete 4-channel sound, it might create problems in relation to the 4-channel carrier frequency.

My idea is based on the idea of using one amplifier only so that all channels have identical characteristics at all times. This could be achieved by using synchronised multiplexing multivibrator switching circuits between the pickup cartridge and the amplifier, and the loudspeaker units and the amplifier. The output from each channel of the pickup cartridge would be separately and cleanly fed, in time-controlled increments, into the amplifier by the electronic switching circuit, and then out of the amplifier with suitable gain applied, through a similar and synchronised electronic switching circuit to the appropriate channel loudspeaker units.

Provided that the sampling rate was high enough, the multiplexing would not be apparent to the ears.

I expect that in the days of valve amplifiers, or even with discrete transistors and other components, the cost of the control circuits described could be more than the cost of a second channel amplifier. Now that electronics has reached the sophistication of the integrated circuit, such control circuits could probably be manufactured very cheaply. In this way we could guarantee that all the channels being amplified had identical characteristics and the balance control to accommodate amplifier performance variations would no longer be needed.

I must admit that room acoustics and quadraphonic channel loudness preferences would perhaps still need to be dealt with, and it is more convenient and easier to move an amplifier knob than heavy furniture to achieve the desired effect! Whilst this would seem to cancel out the need for an automatic balance control, the guarantee of identical channel characteristics is still very desirable.

Perhaps further integrated circuits or even simple potentiometer controls could be added to the amplifier line outputs, after the switching circuits, to provide the extra manual adjustment for acoustic preferences. . .Would my idea work, or would such switching circuits as I have described, not be able to handle the power requirements at the speaker end of the amplifier?

I.K. (Yokine, W.A.)

First off, I never can quite understand why some listeners seem to get so up-tight about channel balance in a 2-channel system. To be sure, one should try to minimise disparity in the signal source, the amplifiers, the loudspeakers and the room layout. If disparity is observed, it is logical to take what corrective measures one can — then set the balance control for the best subjective result and settle back to enjoy the music!

Maybe I'm a Philistine but, having thus set the controls for good average listening (i.e. volume, bass, treble, balance) I don't fiddle with them a great deal from one recording to another. The balance control in particular tends to collect dust.

Perhaps there's more in that remark than meets the eye. Apart from the obvious implications about personal perception and tolerance, minimal re-setting of the volume and tone controls tends to take the emphasis off one possible source of unbalance, namely inaccurate tracking of controls, particularly of the rotary kind.

The less you fiddle, the less you have to!

However, these sentiments are obviously not shared by everyone and, as we remarked earlier, plenty of people do get up-tight about the question of channel balance. This leads to two more or less standardised suggestions or requests from readers, neither of which are identified with our present correspondent:

1: Tell me how to make up an indicator that will show clearly when I have the balance control properly set.

2: Tell me how to build an automatic gain control unit that will maintain balance between the channels at all times.

Both requests have to be set aside for the one basic reason. Both assume, quite wrongly, that the content of the respective channels is similar and therefore capable of precise visual or electrical balance.

In fact, stereo signals are balanced in terms of one component only — that which is intended to create a centre or "mono" image; that much of the total signal should have the same amplitude and phase in both channels. But what about the rest of the signal information? What about the recording which has an artist predominantly on one channel and the accompaniment predominantly on the other? And what about recordings when the strings on the left are supposed to be dominant until it is time for the woodwinds on the right to take over the theme?

Twin level indicators, as fitted to tape recorders, are useful in making sure that the long term levels in the respective channels are commensurate and within the capabilities of the recording system. But the same indicators can show quite dramatically the short term differences between the two signals.

Any system which tended to counteract these differences, whether manually or automatically, might satisfy the eye but it would play havoc with the dynamics, as judged by ear.

Correspondent I.K. does not fall into this trap but suggests that, at least, amplifiers could incorporate a supersonic signal source and gain sensing circuits in each channel so that their balance would be

AMATEUR "FRATERNITY"

Recently, I had a telephone chat with an acquaintance who happens to be a licenced amateur. He reported that one of his amateur "friends" had bragged to him about the fact that he had managed to "shoot down" a radio controlled model by injecting a very high powered signal on to the 27MHz band.

My informant said that he had "ticked him off" but the other character felt that he had been insulted and went off in high dudgeon.

It takes all sorts to make a world apparently.

B.R. (Springwood, NSW)

maintained at all times. I can see a number of objections to the idea:

As a prime requirement, any such scheme would have to maintain balance between the channels in the middle register, on which the ear's judgment of loudness is based. However, a monitor system operating at 20kHz or higher would be affected by the setting of treble tone controls, filters, loudness compensators, &c. These would all have to track within a total discrepancy of 3dB if the 20kHz monitor system was to remain valid for the middle register. The solution might well be more of a problem than the problem itself!

Furthermore, the introduction of supersonic signals into any amplifier system is not to be accepted lightly. Each such signal increases the risk of audible whistles or audible transients, produced by beating with other supersonic signals or very high audio components.

Finally, the proposed monitoring system would control only the replay amplifier and therefore only part of the total reproducing chain. In fact, in these days when the gain of most stages is stabilised by feedback, the replay amplifier may well be a minor part of the problem. What about the recording chain itself and the local transducer and its tracking conditions from one recording to the next?

Dwell too much on these other factors and one might almost register surprise that the system works as well as it does.

Maybe it doesn't — maybe I shouldn't be enjoying it as much as I do!

I'm afraid that I can't generate any greater enthusiasm for the alternative suggestion of using one basic amplifier and a time multiplexed system to sample four signals and drive four loudspeakers. The tacit assumption seems to follow that balance problems would thereby be obviated automatically.

In fact, the loudness of the signal in the respective channels would become a function of their "on" time. Thus a requirement needing to be satisfied would be that the "on" times and the effectiveness of those on times would be the same for all channels, within whatever tolerances one could accept — say 3dB figure implied by our correspondent.

These days, digital circuitry could provide precise pulses to govern the on times, but the problem would not end there. The elemental pulses would have to operate through a lot of additional circuitry to switch the signals at the input and output of a high-powered amplifier, without compromising the signals or the behaviour of the amplifier or transducers.

High powered? Yes, high powered.

If you want, say, 15W RMS available to a loudspeaker, and it is being driven less than half the total time, then the drive to it during the "on" periods would have to be something more than 2x15W. And the amplifier, driving two such loudspeakers, would need to have a power rating of something over 30 watts.

For a quadraphonic system, the amplifier would need to deliver at least 60 watts. You certainly wouldn't get something for nothing.

Power aside, one of the nasty things about "switched" amplifiers is that it is almost impossible to measure their actual working performance. This much emerged strongly some years ago, when Editor Jim Rowe had an argument in print with the manufacturers of the Sinclair class D amplifier. The point is that the switching signal has an amplitude at least equal to the fundamental signal and therefore far in excess of distortion, noise and hum components.

Having in mind that it is virtually a broad spectrum RF signal (20kHz square wave) it radiates, and penetrates and virtually defies any practical order of filtering — at least when you are trying to measure distortion, noise, hum, cross-talk, &c, at levels which might be between 40 and 70dB below the signal fundamental.

So you are faced with an amplifier having the same gross power rating as multiple channels, an array of digital switching circuitry which may or may not be practical, and no easy way of measuring the performance of the finished amplifier in a number of important respects.

At worst it would be a monster; at best it would have provided a complicated solution to a problem which not too many people seem to worry overmuch about; and it would be lousy with supersonic energy, ready to heterodyne with tape bias, FM subcarriers, CD-4 carriers, or just plain high order signal harmonics.

Almost as a throw-away line, I.K. concedes that domestic and acoustic environmental considerations would probably make an accessible balance control necessary, anyway. It simply gets back to the question of how much you are prepared to use such a control — or to tolerate short-term variations from what might seem optimum balance in given program.

Swallow camels if you want to. I'm quite content to identify with gnats!

INTERFERENCE PROBLEM

In the January issue, we published a letter from a Victorian listener who preferred only to be identified as "Fed Up." He complained that interference on the crowded broadcast band made it impossible to listen to distant stations, even with a high performance receiver.

We explained the reasons for this situation and believed that the matter would rest there.

But no! In a rather emotional response "Fed Up" expresses the conviction that the whole thing is part of a plot to prevent city listeners tuning to country stations. That we are part of the plot is proven by the fact that we omitted the customary list of stations from the January issue.

One point that did emerge was that his complaint had not only to do with heterodyne whistles, which he could understand, even though he resented them. What really got him fired up were "ringing sounds, with a fast staccato note in the background." These could only be transmitters injected into the band for a clandestine purpose — further demonstrated by the fact that the PMG Dept will neither admit their existence nor take measures against them!

In fact, it seems highly likely that "Fed Up" is hearing teletype stations breaking through into his broadcast band receiver, either directly into the IF channel, or into the front end as an image or overload modulation. It's actually a fairly common phenomenon related much more to receiver design than to frequency allocation.

Whether he'll believe this is another matter. Any more than the fact that we omitted the station list because of pressure in space for other material!

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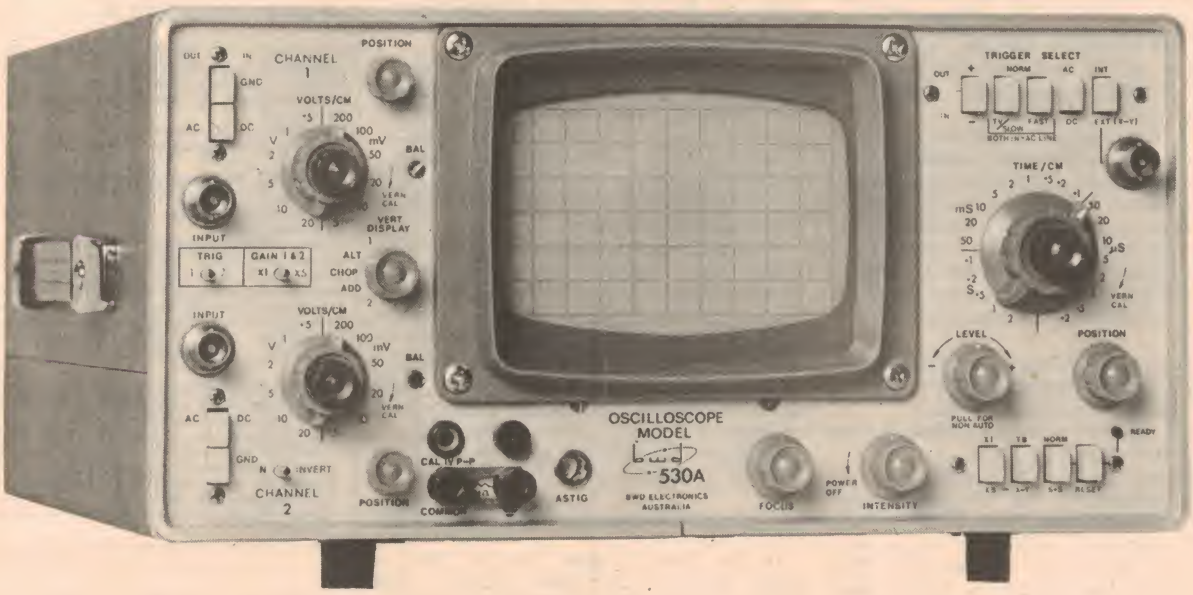

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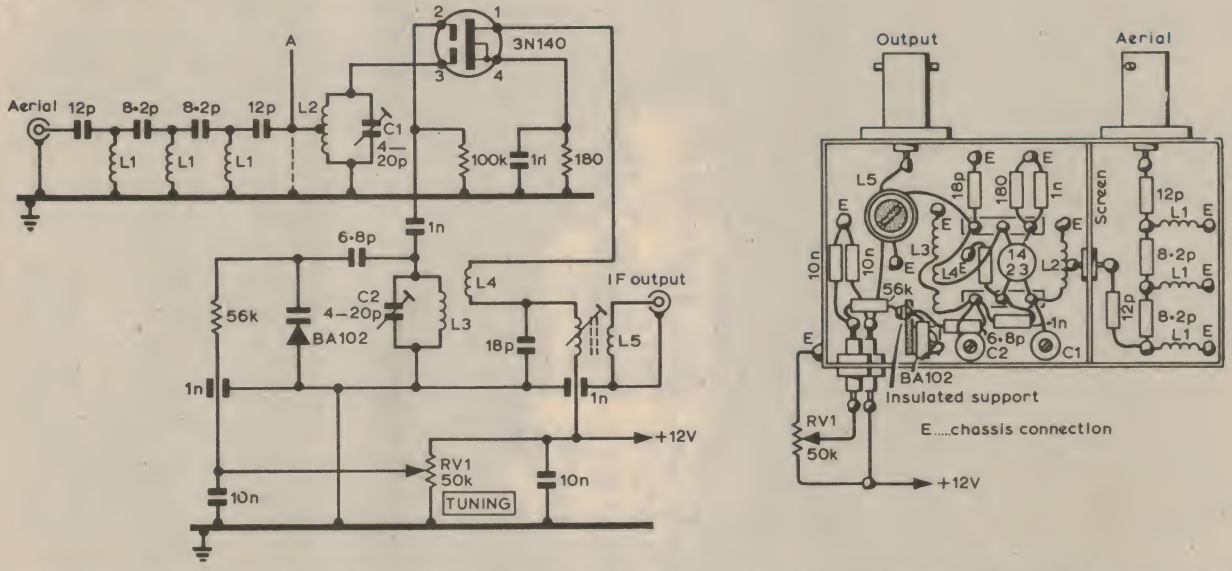
Circuit & Design Ideas

Interesting circuit ideas and design notes selected by the Editor from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsiblity cannot be accepted. Contributions to this section are always welcome.

Single MOSFET 144MHz converter



A single-device 144MHz converter may seem a throw-back to the days of the super-regenerative receiver and may not appeal to the more serious minded VHF operators. On the other hand it represents the type of challenge that some amateurs find irresistible. So for them at least, here is the circuit diagram of a tunable 144MHz converter originally described by Goliardo Tomassetti, I4BER, in "Radio Vista", but picked up from "Electron". IF output is about 27MHz and the fairly elaborate high-pass input filter minimises direct breakthrough. The converter is based on a dual-gate MOSFET in a self-oscillating arrangement not unlike that of the single-gate self-oscillating mixer described earlier in Technical Topics and "Amateur Radio Techniques".

The coil details are as follow: L1, 5 turns spaced 1mm with 2mm diameter; L2, 8 turns 6mm core; L3, 5 turns as L2; L4, 3 turns 6mm; L5, 15 turns 0.32mm spaced on 6mm with 1 turn coupling link. A 40673 or MPF121 MOSFET would be preferred to the 3N140 as they have built-in protective diodes.

This type of converter, with suitably modified input arrangements and changed inductor values, might also be suitable for those looking for a simple unit for one or more HF bands.

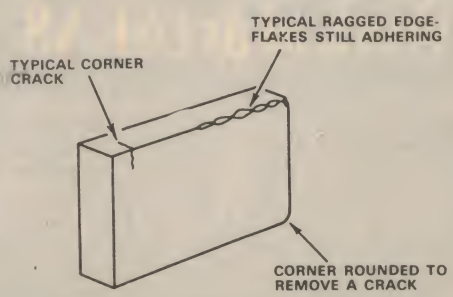
(From "Radio Communication".)

Quartz crystal repair

Having just completed the repair of a defunct quartz crystal, it occurred to the writer that it might be of interest to other readers. Any risk involved in attempting a repair would seem to be worth taking.

When a previously good crystal refuses to oscillate it is reasonable to suspect mechanical damage. A minute crack on one edge of the crystal can be sufficient to stop oscillation. Sometimes the presence of a crack is indicated when the crystal needs an excessive voltage to ensure oscillation.

Repair is only possible if the crystal can be removed from its holder. The crystal is examined for cracks, or for flaking along the edges. The cracks may be difficult to see and polarised light is a help here, thickening up the stressed areas to black pencil-like lines. Polaroid spectacles could be used for the purpose.



Repair consists of grinding the flaked areas smooth and generally entails rounding one corner. The quartz is brittle, so a fine stone must be used, holding the quartz in a paper handkerchief. If no cracks can be seen it may be worth while to run the edges over the grindstone, as this will detach any cracked flakes.

So long as no material is removed from the large faces the frequency should be largely unaffected since it is mainly determined by the thickness of the plate. Degrease the crystal before reassembly, to ensure good operation. The last crystal repaired by the author had a 1mm x 1mm crack on one corner and it was brought into operation again by rounding off this corner.

(By T. E. Millsom, in "Radio & Electronics Constructor.")

Stereo amplifier as variable AC source

Here is how to turn an ordinary hi fi stereo amplifier into the power supply for a variable frequency power source. The setup produces a regulated AC output voltage that typically contains less than 0.2 per cent distortion and that is adjustable from 0 to

Work of art 6EA8

Craftsmanship in metal and glass. The AWV 6EA8 oscillator/mixer valve: eyes and ears of the television receiver.

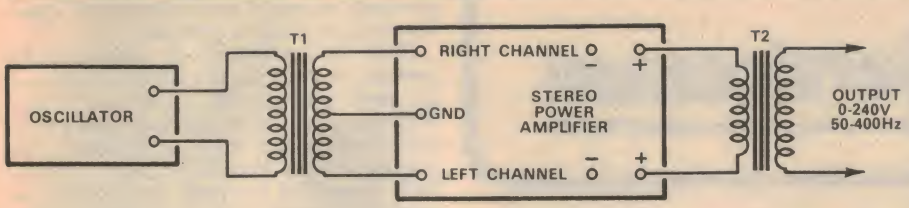
A work of electronic artistry created to pluck a television signal out of the air, designed to receive both audio and video signals, and constructed with the technical perfection of all true works of art.

An example of the special beauty that AWV sees in both the function and design of electronics.

An object no less beautiful because of its everyday application.

For AWV, electronics is a living art.

Amalgamated Wireless Valve Co. Pty. Ltd., your experts in the art of electronics.



240 volts RMS at any frequency between 50 and 400Hz.

The two channels of the stereo amplifier are driven 180 degrees out of phase with each other so that the load can be connected differentially across the amplifier's "hot" output terminals. This technique avoids the inherent danger of paralleling the outputs of a transistorised power amplifier.

The output power available depends primarily on the particular power amplifier used. Naturally, the amplifier's power bandwidth characteristics must satisfy the application. Usually, any oscillator that has an RMS output of 5V with less than 0.05 per cent distortion will be adequate. If the precise operating frequency matters, then the oscillator's frequency accuracy and stability also are important. In some applications, a frequency counter might be a useful addition.

Transformer T1 provides two equal amplitude but opposite phase drive signals for the power amplifier. Since most hi fi power amplifiers have an input impedance of around 50k, impedance matching need not be considered. Transformer T1 must have a good low frequency response and a turns ratio that provides the proper drive level for the power amplifier. Generally, a turns ratio (from primary to each half of the secondary) of 1:1 or 2:1 is suitable for most oscillator / amplifier combinations.

A good frequency response from 50 to 400Hz is also essential for transformer T2.

Contributions from readers for Circuit & Design Ideas are always welcome. However, to ensure that your submission will receive a favourable assessment, it is most desirable that the contents be well set out and include all relevant information. This does not mean that it should be lengthy; rather, be as concise as possible. Submissions should preferably be typed, or neatly written, and double spaced. If we are faced with the situation where a good idea is badly presented, we may not be able to afford the considerable time needed to bring it into shape, and may be forced to look elsewhere.

The turns ratio required for T2 depends on the power output rating and load characteristics of the power amplifier. To determine T2's turns ratio, it is necessary to compute the amplifier output voltage (per channel) appearing across the specified load impedance (which is usually 8 ohms) at the maximum rated output: E is equal to the square root of Pout times R load.

Since transformer T2 is operated "backwards", select a 240 V power transformer with a secondary voltage rating that is twice this calculated amplifier voltage.

(By M. J. Salvati, in "Electronics".)

More on the logic probe

Further to Mr Bolitho's modified logic probe design in January 1974, which was based on an earlier probe by Mr C. Bell, which appeared in Circuit and Design Ideas in March, 1973, we have had a letter from Mr Bell firmly justifying his original design. We note that Mr Bolitho considered that the over-voltage protection was inadequate and made modifications accordingly. Also, he considered it desirable to make changes to a number of other circuit components.

Mr Bell writes that he considered the amount of over-voltage protection as sufficient and so this becomes a matter of opinion and design philosophy. While Mr Bolitho chose to make alterations to suit his own purpose and ideas, Mr Bell has provided a lengthy and detailed analysis to defend his original design. Space will not permit us to reproduce this here, however. From the readers' point of view, we suggest that they read all the published items relating to this probe and decide for themselves which approach to adopt.

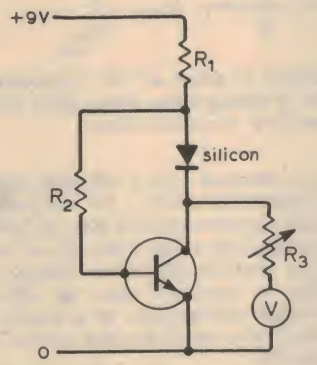
Measuring transistor gain by multimeter

This transistor checking device has the advantage of simplicity in checking silicon transistors, in which leakage current is negligible. It measures gain satisfactorily over a wide range, indicating directly on the ohms scale of a multimeter. The meter is set to give full scale reading by adjusting R3 with a transistor with base and emitter only connected. (The meter is used as a voltmeter, R3 being such as to bring it to approximately 9V full scale.) When the collector is connected, beta will be given by the reading on the ohms scale, provided R2 is equal to (Rmid — 1)R, numerically. The value of Rmid is the mid-range value of the ohms scale and R is the parallel combination of R1 and the total resistance in the meter circuit.

In my case R1 equals 1k, the meter resistance was 300k and could be neglected and Rmid was 18 ohms. The use of an 18k resistor for R2 was sufficiently close for practical purposes.

As an alternative, R3 may be adjusted with the transistor removed to give a meter indication of "-1 ohm", that is, just beyond the full scale reading.

Once the meter is set it does not need readjustment while similar transistors are being checked. If the ohms scale is not of a suitable range, it may, of course, be



multiplied by a factor so long as R2 is calculated using the "scaled" Rmid.

(By R. G. T. Bennett, in "Wireless World".)

The Serviceman

Intermittents — real and imaginary

Intermittents are bad enough when they are genuine; when a fault looks like an intermittent, but isn't — well it's anybody's guess how long it will take to find. I have a story about both the real and imaginary types this month.

The first story is about the genuine type. It was related to me by a colleague who is not strictly a serviceman, but is involved in the electronics industry. Inevitably he is presented with a "love" job from time to time — aren't we all. Anyway, it's over to him.

This job concerned a small portable stereo record player with an annoying intermittent fault in one channel. The sound would occasionally cut off and on, but mostly it would just cut off and stay off after about 15 minutes of operation. With this much to go on, I took the player from my friend and set it up for a listening test.

Initially, nothing went wrong — or I should say, nothing went right. No matter what I did to the machine it played faultlessly. But that's always the way with intermittents.

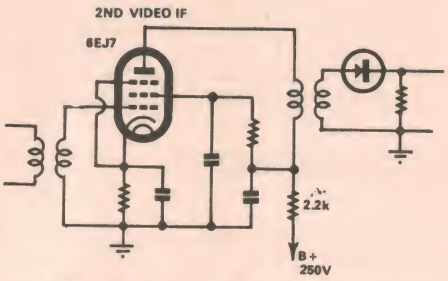
At the next session I had with it, the sound cut off in one channel after about 10 minutes. I nastily grabbed at the volume control and turned it up, whereupon the sound came in again. Turning the control back to the initial level cut the sound out again. I seemed to have a level-sensitive fault, or maybe it was heat-sensitive. Playing about with the volume control, I could cut the sound in and out, almost at will. Then it cut out altogether and I resigned myself to pulling it apart to check through the circuit.

The amplifier used a simple 4-transistor complementary symmetry circuit with a germanium output pair. With one channel still malfunctioning I did a quick voltage check throughout the circuit, comparing readings in the bad channel with those in the good channel. This is a decided advantage when servicing a stereo set — you generally have a basis for comparison as usually only one channel fails. Still, the test revealed nothing. Readings in both channels were almost identical.

Then, as fate would have it, the set came good again and nothing I could do would make it malfunction. I was becoming really frustrated. Then I hit upon the idea of testing whether the fault was heat sensitive — by bringing the tip of a hot soldering iron close to each component in turn. This revealed nothing. So I put it aside for the time being.

Next day I set it up again and after about 10 minutes playing it began to play up. But I was no closer to solving it. After all, there did not seem much to go wrong with the circuit and voltage checks showed nothing. Or did they? I looked at the circuit diagram which I had sketched out hurriedly and I realised suddenly that the voltage check did contain useful information. Since the circuit was direct coupled, lack of voltage change when it malfunctioned suggested that the fault must be in one of the few places wnere AC coupling was involved. Or looking at it another way, the voltage check absolved the great majority of components, leaving only one or two under suspicion.

And, as I reached this conclusion, I realised that there was one component which, if faulty, could account for all the symptoms I had observed — the output capacitor must be intermittently open circuit. That would even explain why the fault was apparently level sensitive.



The second IF stage of the "intermittent" receiver. A wrong value decoupling resistor produced the strange effects.

When I realised this I felt like kicking myself around the room — for two reasons. One, I had experienced this type of fault on several occasions some time ago in power amplifiers used in jukeboxes. Second, the capacitor in question was an obsolete locally made electrolytic, of a brand and type which was notorious for intermittent open-circuits.

I lost no time in replacing the capacitor. And, of course, it was as right as rain after that with the owner making the common comment, "It's never played better."

But it was a most annoying job for me. First, because I'd had the experience to pick such a fault straight away. Second, if I had been able to trace an AC signal through the amplifier it would have been a simple fault to find, but this is a phase of servicing with which I have had little experience. And, in any case, I just did not have the necessary equipment available in my home workshop. Most of the time I was limited to a multimeter.

Well, that's my friend's story and I encouraged him to tell it, as much as anything, because it gives me an opportunity to make some comments about servicing techniques generally.

First, his remark about comparing the voltages in the faulty channel with those in the good channel. This is such an obvious trick that I wonder why anybody needs to be told about it. Yet the truth is that a surprising number of people appear never to have thought of it. Home constructors, in particular, could often save themselves a lot of headaches if, when faced with a fault in a just completed piece of equipment, they would make a simple comparison between a channel which is misbehaving, and one which appears to be normal.

It's a handy trick for the serviceman too, particularly when faced with a piece of foreign equipment for which there is no service manual or circuit diagram. It often means the difference between tackling the job and turning it down.

The trick with the hot soldering iron is worth remembering also; it is surprising how often it will reveal a heat sensitive component.

As for my colleague's frustration at overlooking the very component with which he had already experienced similar faults — well that can happen to the best of us, but part of learning to be a serviceman is learning to mentally file such experience for future use.

And, finally, there is his comment about tracing a signal through the amplifier. While it is easy to be wise with the benefit of hindsight and — by Murphy's Law — our first approach to a problem is always the wrong one, I feel bound to say that signal tracing still seems to be the best overall method of tackling the intermittent fault. Assuming, that is, that one has the equipment readily available to do the job.

My second story might well be sub-titled, "The intermittent that wasn't." It caused me some headscratching for a while.

It was an early model TV set and the owner complained that it lost both picture and sound intermittently, leaving a white screen. It was a fairly old set, from a small manufacturer, using a 21in tube.

I tend to be a little cautious with sets as old as this. Quite apart from the immediate failure which prompts the service call, one is likely to find that they have been let run down to the point where half the valves need replacing, a lot of the older capacitors are leaky, and a fair number of adjustments are needed to produce a good picture. The cost is often more than they are worth; or, at any rate, more than the customer is willing to pay.

However, this set looked clean, used mostly stock parts, and appeared to have been serviced recently, judging by a number of modern components in place of the old ones. It was also a set which had been designed with ease of service in mind. Against this background I decided to give it a go. So I hooked it up on the far end of the bench along with a couple of other intermittents, plugged in a pair of rabbit ears, and let it run. It produced a first class picture.

A couple of days later I realised that it was still producing a first class picture, and that it had not so much as blinked during that period. I decided it was time to come to grips with it.

I transferred it to the regular workbench, plugged it into the regular bench antenna

(outside), and switched on. I was greeted by a white screen and nothing else. I switched to an adjacent blank channel and produced snow on the screen and the sound from the previous channel. On an impulse I disconnected the outside antenna and reconnected the rabbit ears, and immediately received all channels without any trouble. Well, perhaps it was an intermittent, but I was becoming very suspicious.

I took the test one stage further. I reconnected the rabbit ears and moved these around the shop. I knew from previous experience that I could vary the signal strength over a wide range by this method, some parts of the shop providing very little pickup and others, particularly near the outside antenna feedline, a solid signal.

The result was very interesting. While the original two conditions were quite clear cut — one would work, and one wouldn't — I found that there was a fairly critical level between these two extremes where, for want of a better word, the set "dithered".

More precisely, it might or might not resolve a signal around this critical level. Or it might resolve the signal initially and then, due to some fluctuation in signal strength (aircraft flutter for example) suddenly elect not to resolve it. What was more, it appeared that once it locked a signal out, it would not readmit it if the level simply reverted to that which it was previously handling; it was necessary to either drastically reduce the level or, in some cases, remove the signal altogether.

This behaviour, coupled with a relatively poor signal strength area in which I knew the owner lived, would explain the erratic behaviour and why the customer imagined the fault was intermittent. In a sense, I suppose it was but I was convinced that there was no intermittent fault as such; no dry joint, varying value resistor or capacitor foil with poor contact. It was simply intermittent behaviour due to the set's sensitivity to varying signal strength.

Having reached that conclusion my first reaction was to suspect the video amplifier. Where the video amplifier is directly coupled to the grid of the AGC valve, as it was in this case, any significant drop in plate current in the video amplifier, as by ageing, can seriously upset the AGC valve bias and operating conditions. The result can be excessive AGC voltage which, in extreme cases, can suppress both picture and sound.

So I tried a new video amplifier valve, a 6DX8, but this had no effect. Next I considered the possibility that one of the video IF amplifier valves was sick, possibly resulting in some kind of clipping action which was upsetting the AGC system. So I tried new IF valves, a 6EH7 and a 6EJ7. Again no improvement.

With the most likely valves ruled out for the moment, I turned the chassis over and reached for the VTVM. With the set connected to the outside antenna my first measurement was the AGC voltage upplied to the first IF valve. It was nil and, as far as I could determine, there was also little or no video signal across the video amplifier load resistor.

Since I knew that the set would work on a weak signal, it appeared that it was choking up somewhere in the tuner or IF system when fed with a strong signal. I ran the VTVM probe over the pins of the second IF valve and produced some surprising figures; both plate and screen read only 25 volts, which was low by any standards for such a stage.

The IF transformer primary was fed from the HT line via a decoupling resistor, and a measurement on the other side of this showed 250 volts. I took another look at the decoupling resistor; was one of the recently replaced components and, unless I was going colour blind, it was a 39k. This seemed rather high for such an application, so I reached for the circuit diagram again and checked. It said 2.2k, which was a much more reasonable figure.

I measured the suspect resistor, confirmed that it was 39k, then hauled it out and fitted a 2.2k. The set came good immediately and handled weak or strong signals with equal ease.

I'm not sure how this situation came about, but I suspect that the original resistor had failed and the previous serviceman was temporarily short on 2.2k replacements. He probably intended to substitute a 3.9k but had confused the colour coding and selected a 39k. Assuming a low signal strength situation, there would have been no immediate indication that anything was wrong.

Which prompts me to raise another point; have you noticed how difficult it can be to distinguish some of the more subtle colours in the tiny bands on today's fractional wattage resistors? The colour TV engineers are quite right when they claim that the eye cannot distinguish colour in fine detail, and it is very easy to make a mistake. The situation is made worse if one should be wearing glasses, but isn't.

But even when wearing glasses I have sometimes found it necessary to use a low power glass in addition, just to make quite sure. And sometimes the extra magnification has shown my first selection to be wrong.

Be that as it may, and regardless of how the 39k resistor was substituted, the set didn't like it. Exactly what the failure mechanism was I am not perfectly sure. The most likely explanation would seem to be that, in the absence of any AGC signal to either the tuner or the first IF stage, the latter simply choked up when fed with a solid signal. There is quite a lot of resistance in its grid circuit and a strong signal might easily generate grid current and enough spurious bias to cut the stage off.

And the lack of AGC was due to the failure of the second stage to provide significant amplification. Thus the AGC system was unable to sense the presence of a strong signal, or generate voltage to control it.

Our New Playmaster 140

This article completes the presentation of the Playmaster 140 quadraphonic amplifier with the description of a decode module for SQ matrix recordings. While intended primarily for use with the 140 Playmaster, the module could quite readily be incorporated into other quadraphonic systems assembled from separate units. Also included is a diagram of the cabinet.

by NEVILLE WILLIAMS — PART FOUR

The decode module is very compact, being assembled on a printed circuit board measuring 76 x 60mm. It operates normally from a supply rail of about 20V and can be cut into a typical system either just before or just after the volume controls.

Fed with left channel and right channel signals, it will deliver outputs for all four channels of a quadraphonic system. While its prime purpose is to decode SQ matrix recordings, it will produce a multi-dimensional output from other matrix recordings, and doubles also as a 4-channel simulator for two-channel stereo recordings.

Distortion is low, noise level is low and the gain from either input to any output is nominally one. It dropped into the Playmaster 140 system without the slightest hint of trouble.

It may be helpful at this point to explain a little of the background.

Although foreshadowed by Blumlein in 1931, the basic idea behind matrix style quadraphonic recording received little or no publicity until it was brought forward by Peter Scheiber in 1969.

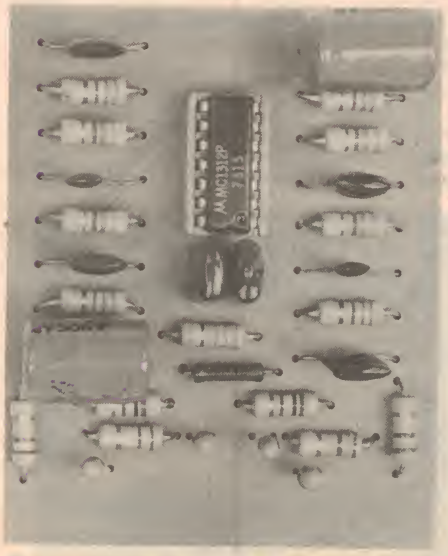
Subsequently, there was much argument about the validity of the scheme but it came to be seen as a compromise which had definite commercial possibilities. Research then went "underground," to emerge later as a whole array of different and competitive matrix systems.

Such was the resulting confusion that the whole idea of matrix quadraphonic was at hazard in the marketplace and, under this kind of pressure, rival companies managed to compact them into two main systems: SQ from the Sony/CBS group and RM (Regular Matrix) embracing the remainder.

It was a step in the right direction but, in practical terms, it wasn't big enough. The circuitry to cope with even two systems was still too clumsy to fit neatly into consumer equipment.

Twelve months ago, or more, we had on our test bench the working prototype of a switchable decoder, using discrete components. However, because of the uncertain status of quadraphonic sound, the complexity of the decoder and the difficulty of merging it with other gear, we discarded the whole thing and settled for our much simpler, though limited "Stereo-24 Adaptor," presented again last month.

Meantime, however, CBS Laboratories in America, in collaboration with Motorola, had come up with a single integrated circuit which contained all the active devices — and some passive components — necessary for a basic SQ decoder. With the addition of a few peripheral components, it made it possible to produce a decode module compact enough and inexpensive enough to slip into a unit amplifier or receiver.



The completed plug-in SQ decode module. There is ample room for everything provided you obtain miniature components. Larger type capacitors would have to be stood on end.

There was just one problem: The IC in question was intended primarily for equipment manufacturers; it could be sold only under licence, and upon payment of a royalty to CBS. That still left the home constructor out in the cold.

However, in their September 1973 issue, our associate English journal "Practical Electronics" described a decoder using the particular IC, the Motorola MC1312P. In the same issue the IC was offered by an advertiser as part of a kit for the decoder module.

With the idea of initiating a similar arrangement, we checked out the circuit, discussed it with Motorola in Australia and then suggested to local suppliers that they seek a suitable royalty arrangement with CBS. In our December issue, we indicated what was in view, delaying the actual description until supply could be organised.

We gather that there have been discussions overseas about the precise terms of such royalty arrangements and these may have a bearing on the Australian situation. However, we suggest that you be guided by what individual advertisers are or are not able to offer, either immediately, or later if the situation should change.

It is almost certain that the MC1312P will be available only as part of a complete kit, as a condition of the royalty arrangement, and with the royalty fee included in the purchase price. It is of no use writing to Motorola direct. They manufacture the particular item under licence to CBS and are not able to sell outside the terms of that licence.

So much for the commercial and legal constraints. The IC itself transforms a basic SQ decoder from what would otherwise be a large array of discrete components into a very compact module.

But why the specialised treatment for the SQ system?

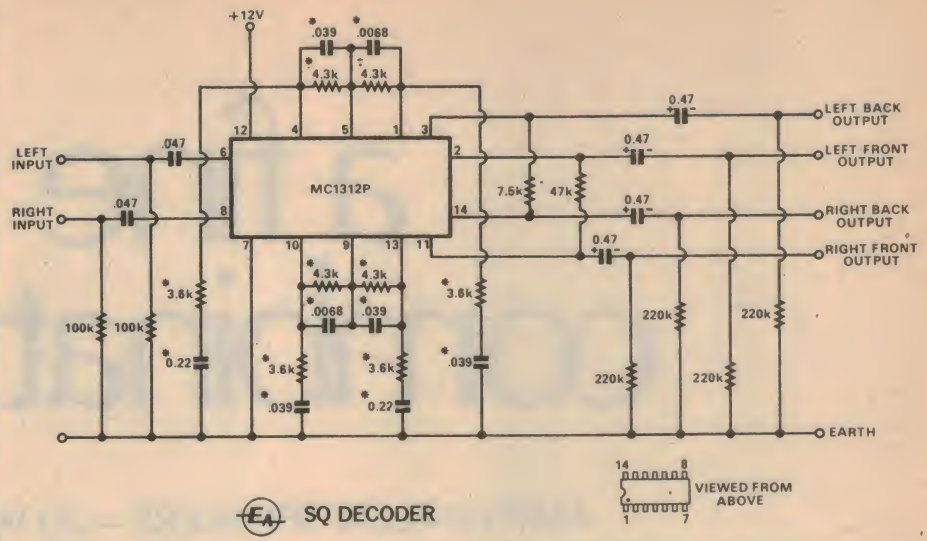
Mainly because the CBS/Sony group have had the initiative to originate and propagate such an IC, along with the appropriate application data.

The other point is that, for the time being, most of the currently available quadraphonic recordings are encoded SQ.

The module provides basic decoding of such recordings and the channel separation available is that inherent in the system. Separation between front left and front right is preserved but separation between front and back signals is only 3dB.

CBS engineers point out that subjective improvement results from some deliberate blending of the front output signals (10pc) and the output signals (40pc). This imposes a limit of 20dB on the left / right front separation but it increases the front / back separation to 7dB.

To achieve greater orders of separation than this, Sony in particular have devised a number of "logic" circuits, so-called. The function of these circuits is to continuously sample the signals at each of the outputs from the basic matrix and, by combining the samples in suitable phase, produce a resultant which relates to what is apparently the dominant signal at any instant. The resultant is used, in the manner of an AGC circuit, to increase the gain of the relevant amplifier channel(s).



The circuit of the SQ decode module, complete except for the decoupling components, which were included in the main chassis wiring. The components shown with an asterisk should preferably be 5pc tolerance types, since they determine the phase characteristics on which the decode function depends.

PARTS LIST

(See text regarding royalty arrangements, &)
1 Printed wiring board 76 x 60mm, 74 / s3.
1 Integrated circuit, Motorola MC1312P.
1 Edge connector to suit, see text.
1 IC socket, optional, see text.

RESISTORS
(¼W or ½W as available)
4 220k; 2 100k; 1 47k; 1 7.5k; 4 4.3k 4 3.6k.**
1 1k ½W (if not already in amplifier chassis)

CAPACITORS
(Miniature types with DC voltage rating 25V or higher)
4 0.47uF tantalum electrolytic.
2 .047uF polyester.
*2 0.22uF * polyester.*
*4 .039uF * polyester.*
*2 .0068uF * polyester.*
1 220uF or 400uF decoupling electrolytic (if not already in amplifier chassis)
*Footnote: *asterisk indicates 5pc tolerance desirable.*

By this means, a signal which may have only a marginal emphasis from the matrix, is augmented in the amplifier chain, thus increasing the apparent separation and decreasing the apparent cross-talk between channels.

While there is room for argument about the merits or otherwise of logic circuitry, it is mainly of academic interest, at present, to the average home constructor. Effective logic circuitry is far more complex than that necessary for decoding and, at this stage, we are happy to settle for the basic system.

The Playmaster 140 provides for external units and for an external full logic decoder, if and when you are tempted to buy one!

The basic circuitry surrounding the MC1312P IC is taken directly from the Motorola application data. No details are given of the internal circuit but the data suggests that the IC contains several amplifier stages, with the appropriate interconnections, and some resistive elements for the Wien bridge type phase shifting networks. The remainder of each network is provided by the peripheral components.

Since the design is the result of collaboration between CBS and Motorola, we saw no reason to question the values suggested.

Most of the capacitor values would be regarded as standard by a supplier, although he may not have them in appropriate miniature form or to the required tolerance.

The resistors include some which are not in the usual "preferred" range but stockists can obtain them from manufacturers or importers. We ascertained, for example, that the Philips organisation could supply them to stockists (not individual constructors) as off-the-shelf items.

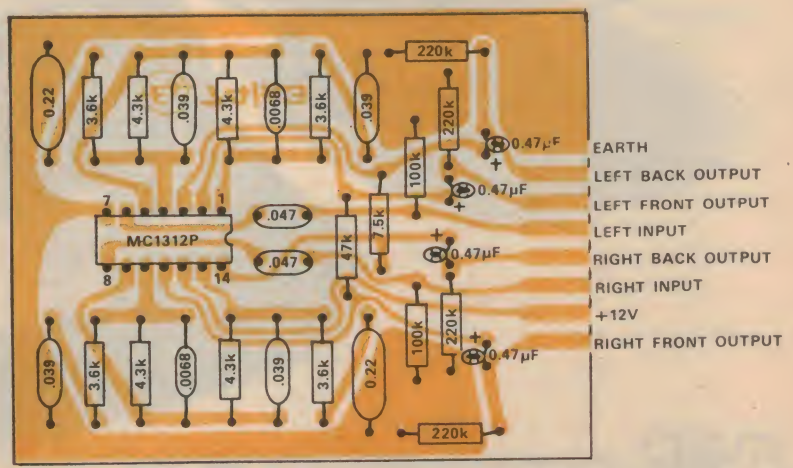
Note that capacitors and resistors forming part of the phase networks are specified as 5pc tolerance. Observe the requirement if you can, although it may not make all that much difference to the sound if circumstances force the use of some 10pc components.

We have shown the blend resistors as permanently wired into circuit, rather than optional or brought into circuit with a double pole switch. If you need to use the Playmaster 140 under conditions of maximum left / right frontal separation, this is available in either of the other mode switch positions.

A further point is that the Motorola data did not extend to complete input and output coupling arrangements. Our circuit and the related module provides for input resistors as well as coupling capacitors, and also output coupling capacitors and resistors. These additions obviate any clicks which might otherwise be produced when the SQ module is switched in or out of circuit.

Because we had a specific application, the module was simply installed in the Playmaster 140 and operated as part of it.

However, for the guidance of those who may wish to use the module in another context, the following information is relevant, taken from the Motorola data:
Supply volts: 20 typ; 25 max.
Supply current: 16mA typ; 21 max.



Layout of the components on the printed wiring board, which is reproduced here full size. The contacts could be gold plated but inquiries confirmed that, for ordinary use, plating is not necessary. The socket should be assembled or marked so that there will be no ambiguity about location of the module.

a fine combination

MSP HI-FLUX SPEAKERS — 20 WATTS

MSP's advanced technology and craftsmanship has produced an exciting new combination of high performance speakers for Hi-Fi applications.

6½" Woofer LF-6WAC-16
A totally new concept in speaker design featuring a unique moulded housing manufactured from the latest high impact glass filled nylon materials, for the ultimate in appearance, rigidity, stability and reliability.
Part Nos. 56328-001/8 ohms.
56328-002/15 ohms.
Resonance: 45 ±7 Hz.
Frequency Response: 35 to 6000 Hz. (With tweeter HF-4MBC 35 to 18000 Hz.)
Voice Coil Impedances: 8 or 15 ohms at 400 Hz.
Compliance (Equivalent Volume): 2000 cubic inches.
Total Q: 0.33.
Sensitivity: 100.5 dB.
Nominal Power Handling: 20 watts RMS in recommended enclosure.

4" Tweeter 4MBC/8-15HF
Part No. 56254-001.
Frequency Response: 2000 to 18000 Hz.
Recommended Crossover: 4000 Hz with 3.3 μF capacitor for 8 ohm system. 2 μF capacitor for 15 ohm system.
Voice Coil Impedances: 8-15 ohms.
Power Handling: Compatible with bass speaker power handling when used with suitable crossover network. An economical alternative can be achieved with a single 6½" wide range twin cone speaker.

6½" Wide Range Twin Cone 6WACX
Part Nos. 56327-001/8 ohms.
56327-002/15 ohms.
Ideal as an extension speaker for stereograms or tape recorders, etc.
Resonance: 45 ±7 Hz.
Frequency Response: 35 to 16000 Hz.
Voice Coil Impedances: 8 or 15 ohms at 400 Hz.
Compliance (Equivalent Volume): 2000 cubic inches.
Total Q: 0.33.
Sensitivity: 102.5 dB.
Nominal Power Handling: 16 watts RMS in recommended enclosure.

Recommended enclosure designs including the application of mid-range speakers and tweeters are available.

4MBC/8-15HF

LF-6WAC-16

msp 554 Parramatta Road, Ashfield, N.S.W. 2131. Phone 797 5757.

N.S.W. George Brown & Co. Pty. Ltd., 519 5855. VIC. AWA Ltd., 67 9161. QLD. Chandler Pty. Ltd., 310341. S.A. Newton McLaren Ltd., 510111. AWA Ltd., 72 2366. Gerard & Goodman Pty. Ltd., 23 2222. W.A. AWA Ltd., 28 6400. TAS. AWA Ltd., 34 3836. AWA Ltd., 31 5466.

A.D.29

PLAYMASTER 140

Input imp: 1.8 meg min; 3 meg typ.
Output imp: 5k ohms.
Input volts: 0.5 typ; 2 max.
Distortion: 0.1pc typ.
Sig / noise ratio: 74dB typ; 70dB min.
Gain: within -1 and +1dB.
L / R balance: within -1 and +1dB.
Op. temp: 0 to +75c.

It will be evident from this table that the module is being operated in the Playmaster 140 at well below the maximum rated voltage, being effectively at about 12V for the two prototypes which we made up. If you have reason to do so, the supply could be increased in the Playmaster 140 by simply reducing the value of the decoupling resistor. However, be prepared to increase also the value of the decoupling capacitor, otherwise power supply ripple could penetrate the signal chain.

In point of fact, subsequent to publication of the December issue, we increased the value of the decoupling capacitor to 400uF, to ensure the lowest possible ripple at this point.

The circuitry can most logically be put together on a printed wiring board and, with this in view, we produced the board shown here and coded as EA board 74 / s3. It measures 7.6 x 6cm, being the same size and having the same external connections as the board originally suggested by "Practical Electronics" magazine.

For our purposes, however, we completely redesigned the pattern, providing for the additional input and output components, as mentioned earlier. There is room on the board for everything — provided you use modern miniature components. If you have to use some older, more bulky components, it will be necessary to resort to such measures as standing resistors on end or mounting capacitors well above the surface of the board. Electrically this will be of no consequence and, fortunately, there is room in the chassis to accommodate a more bulky assembly.

As with any compact wiring board, and especially one involving an IC, it is essential to use a small iron with a clean, sharp tip and apply the solder sparingly but quickly to each point. If the solder doesn't flow immediately, don't fiddle with the iron tip on the board in the hope that brute force — or brute heat — will do the trick. Try to scrape the offending surface with something small and sharp and try again.

Be particularly careful with the connection to the IC itself, first to get it round the right way, as indicated by the indentation on one end, and secondly to avoid overheating or bridging the connections while soldering.

If you feel at all apprehensive, it is possible to buy a suitable socket (McMurdo, & c) which can be soldered to the board. The IC then plugs straight in with little risk of incident or accident. We installed such a socket in our prototype, not just for this reason, but to have a test-bed into which we could plug other specimens of the IC.

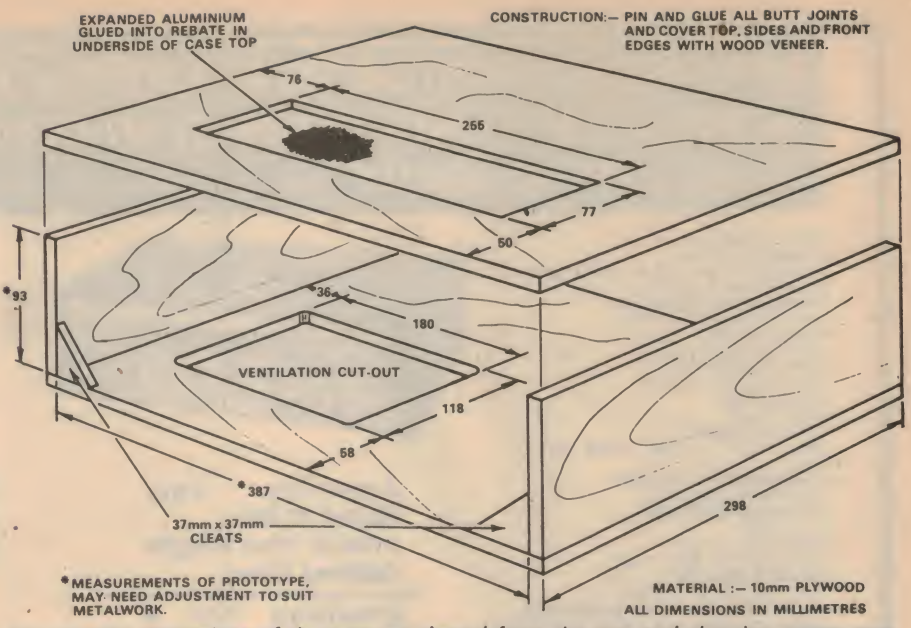
Incidentally, the writer is not too proud to admit having an old-fashioned reading glass handy on the bench. It makes it a lot easier, upon completion of such a unit, to inspect it for solder runs, or "whiskers," dry joints and so on.

For the rest, it is simply a matter of identifying the components and placing them correctly on the board. If you do this, the module can hardly do anything else but work!

As will be apparent, the module is designed to plug into a PC edge connector of pitch 0.15in and of sufficient length to accommodate the 6mm or 2-3 / 8in width of the board. The connector lugs must be sufficiently stubby to clear the bottom of the chassis when the module has clearance height at the top.

We used McMurdo Redline PC connector, which is available either in a kit pack or as a made up unit. We bought one of the latter over the counter and mounted it on a couple of spacers, while retaining enough clearance at the top of the module.

With the module on hand, the connections can be identified readily. Just make sure that the board mates correctly with the contacts and, if the connector is longer than necessary, take some step to ensure that it will always be plugged in correctly. The



Approximate dimensions of the case, as viewed from the rear and showing corner stop cleats. If built this way, case dimensions should be matched to the individual chassis. An alternative approach would be to push the chassis in from the rear, with a small picture frame beading at the front to cover clearance space around edge of the chassis.

Authorised Fairchild distributors in Australia are:

NSW: Warburton Franki (Syd) Pty Ltd, 199 Parramatta Rd, Auburn 2144. George Borwn & Co Pty Ltd, PO Box 35, Camperdown 2050.
VIC: Warburton Franki Ind (Melb) Pty Ltd, 220 Park St, South Melbourne 3205.
SA: Gerard & Goodman Pty Ltd, 192 Rundle St, Adelaide 5000.
QLD: Warburton Franki (Bris) Pty Ltd, 13 Chester St, Fortitude Valley, 4006.
ACT: George Brown & Co Pty Ltd, 23-25 Whyalla St, Fyshwick 2604.
WA: Warburton Franki Pty Ltd, 41 Great Eastern Highway, Riverdale 6103.
New Zealand readers can obtain their Fairchild power kits (7 transistors) from Tee Vee Radio Limited. (See coupon).

NEW ALL-TRANSISTOR STEREO AMPLIFIERS WITH IN-BUILT A.M. TUNER ULTIMATE IN DESIGN— LONG DEPENDABILITY using all silicon transistors 50 WATTS – RMS

SPECIFICATIONS
POWER OUTPUT:
25 watts per channel R.M.S. Total output 50 watts R.M.S. 8 Ohms
FREQUENCY RESPONSE:
20 cycles to 40,000 ± 1db.
HUM & NOISE:
Aux. 70db. Mag. 60db.
INPUT SENSITIVITY:
Mag. 2mv. Aux. 250mv.
EQUALISED:
Mag. RIAA.
TONE CONTROLS:
Bass 50 c s ± 13db. Treble 10kc s 15db.
HARMONIC DISTORTION.
Less than 0.5 per cent.
LOUDNESS CONTROL:
50 c.s 10db.
SCRATCH FILTER:
(high filter) at 10kc s 5db.
RUMBLE FILTER:
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PROVISION FOR TAPE RECORDER.
Record or play back with din plug connector.
SPEAKER SWITCHING:
Two sets of speakers can be connected and selected by switch on front panel they can also be driven together.
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Headphone jack is situated on front panel.
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16 ½in X 11in. deep X 5" high Weight 16lbs
TUNER:
This unit incorporates a transistor tuner with a coverage of 530 to 1,600 K. C. Calibrated dial available for all states.
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Regulated power supply with switching protection for output transistors.
SEMICONDUCTORS.
30 silicon transistors plus 7 diodes.

$169.00 Plus Freight
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Model C700-T (with Tuner)

Amplifier Only
Model C.700
$139.00 Plus Freight
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Provision For 4 Channel

All units wired with sockets & control for simulated 4 channel only requires the addition of two extra speakers, also output socket for decoder.
Cabinets for above amplifiers in Teak or Walnut Oiled Finish with matching metal trim $10.00 extra

20 WATT STEREO SYSTEM FOR *$199.00*

MONARCH 20 WATT STEREO AMP WITH SEPARATE BASS & TREBLE CONTROLS, LOUDNESS CONTROL & HIGH FILTER.

THE NEW GARRARD 3-600 CHANGER WITH SHURE M75-6 MAGNETIC CARTRIDGE FITTED WITH CUEING CONTROL & ANTI - SKATE, FITTED IN BASE WITH PERSPEX COVER.

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— NEW MAGNAVOX-PHILIPS 3 WAY SPEAKER SYSTEM —

FREQUENCY RESPONSE 35Hz to 25KHz
POWER HANDLING CAPACITY 30 Watts R.M.S.

DRIVE UNITS:
Magnavox 8-30 High Performance 8in Bass Unit • Magnavox 6.J — 6in Mid Range Speaker • Philips High Fidelity Dome Tweeter
COMPLETE SYSTEM in 1.6 cubic ft. cabinet. In Walnut or Teak Veneer (Size 24" x 15 ½" x 11").

SPEAKER KIT: (less cabinet) comprising 1 8-30 speaker, 1 6J speaker, 1 Philips dome tweeter, 1 1mh. inductance, 1 8 mfd. & 1 4mfd. polyester condenser, 1 3" & 1 6" tube, innabond & speaker silk, plans for cabinet.

$72.00 ea. *Regret no Mail Orders for Complete System.* **$40.00** *Reg. Post & Packing $3 Extra.*

PLAYMASTER 136 STEREO AMPLIFIER

As featured in Dec 72 issue of Electronics Australia

High fidelity amplifier with an output of 13 watts R.M.S. per channel, frequency response 20Hz to 120kHz, distortion 0.2% mag. input equalised to R1AA, bass & treble controls, provision for simulated 4 channel.
Complete kit of parts including **All Transistors. $65.00** as above but less Fairchild **special transistor offer $58.00.** Reg postage $2.00 extra.

As an added feature to the 136 amp we have added provision for headphones with phone jack & switch mounted on front panel which is silver anodised with black lettering & matching knobs. We have also had a special transformer wound for this unit with separate 6v winding for indicator bezel & with electrostatic shield.

Post & Packing $1.50 extra (reg. Post)

At last a breakthrough in the cost for high quality portable radio transceivers of the walkie-talkie hand-held type. We are introducing and offering for sale a fully PMG approved transceiver.

MIDLAND 1 WATT TRANSCEIVER MODEL 13 / 700

For 27240 or 27880 Khz operation (state which required) with switch position for additional channel, tone call signal, noise squelch control, circuit contains 12 transistors, diode and thermistor. Transmitter stability crystal controlled .005 . Aerial 13 section telescopic. Powered by 8 1.5v UM3 batteries. Range up to 10 miles depending on conditions. Size 8½in by 3½ x 2in. Price $39.50 per unit.

CLASSIC RADIO

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PHONES 798 7145, 798 6507

connections to be made to the module via the edge connector are shown clearly on page 33 of the December 1973 issue.

Note what we said earlier about the 220uF decoupling capacitor.

That just about completes the electrical description of the Playmaster 140. We may have occasion later to suggest additions or extensions, but, for the time being, we propose to sit back for a while and enjoy the music!

But perhaps we should say a few words about the cabinet work: The up-turned dish chassis lends itself to the fitting of a simple metal hood finished in any way the supplier believes to be appropriate. How simple or ornate, or how cheap or costly such metalwork, will be governed largely by supply and demand.

Although we have not had occasion to investigate the matter, a metal cover with not-too-open ventilation would have a possible advantage in areas close to powerful radio and television transmitters. Curiously, the problem of RF penetration is less likely to occur in the input stages, than directly into the power modules, with their relatively high gain and extremely wide inherent frequency response. When it does occur, such interference is independant of the volume control setting.

But, leaving aside RF penetration, many constructors may prefer to house the amplifier in a wooden case, finished to match other equipment or other furnishings. The case can likewise be a simple item, although not everyone finds it easy to achieve a really pleasing finish.

If you do plan to build your own cabinet, we suggest that you regard our diagram as provisional only and wait until your own chassis is to hand. At this point, the metal work can be measured and the cabinet made to fit snugly — not 2mm too small or with a 2mm gap all around!

Unless you have more facilities than average, and a great deal more skill, you won't attempt 45-degree mitre corners; butt joints are much more manageable.

If using natural timber or veneered particle board, it will be necessary to make some provision to hide the end grain at the corners of the cabinet.

One method is to leave the top very slightly short and to glue strips of veneer against the end grain, flush with the side surfaces. Another method is to make the end cheeks deliberately oversize, butting the top and possibly the bottom against them. The exposed edges of the cheeks can then be dressed with veneer, while the front edges can also be veneered as necessary.

If the cabinet is built with natural particle board the surface can be covered with adhesive wood-grain fabric or, again, with grained laminate or veneer.

You may have your own preferred method of wood finishing but one we have used ourselves is ready-made for the not-too-skilled handyman:

Thoroughly sand the surface, being careful not to introduce linseed putty or a high lacquer content filler, which tends to soak into the adjacent fibres, making them react differently to the rest of the surface.

Now go over the whole surface with one even coat of thinned clear lacquer, allowing it to dry thoroughly. This tends to soak in and partially seal without producing a surface gloss.

If you want a natural timber finish, it may be necessary only now to apply a coat of "teak" oil, rubbing it in with ordinary steel wool (not the soap pads, of course). The result will be an oiled, matte finish, probably about honey colour.

If you want a darker finish, apply an appropriate oil stain before the finishing oil, rubbing it in with steel wool. In fact (let's just whisper this) some professionals use selected shades of shoe polish as a handy and easily controlled form of stain!

Finish with clear oil, wipe over with a soft rag and you will end up with a pleasing matte finish, not easily marked but easily touched up if it is.

FOOTNOTE:

As with the Playmaster 136, a considerable saving in cost is possible by taking advantage of Fairchild's special offer of transistor kits for the power modules. Each kit contains the seven appropriate transistors. Some stockists can supply the special offer transistors as part of a complete kit but the normal method is to obtain them by post, using the coupon on page 75 of this issue or page 35 of the December issue.

New Zealand readers should note that special offer coupons should now be sent to Tee Vee Radio Limited, with addresses as follow: 423 High St, Lower Hutt, (Wellington); 13 Maidstone St, Grey Lynn (Auckland); 22 Manchester St, Christchurch; 121 Crawford St, Dunedin.

Demand for the special offer kits is such that some delays are being experienced but Fairchild say that they should be able to keep pace from now on.

Dual 30V/2A variable power supply

Here is a dual variable power supply specially designed for those who experiment with solid state devices. Using relatively few components, it is easy to build and low in cost — yet will deliver up to 30V at 2 amps from each channel. Both channels are short-circuit protected, and feature regulation adequate for most purposes.

by IAN POGSON

In October 1973, the author described a design for protected power supplies developed from an original idea by A. E. T. Nye, in "Wireless World" for June 1973. Readers who have not read either of the above may wish to do so in order to get the background to the present article, which is a practical application of the principles involved. A suggested alternative to my addition to Mr Nye's circuit has been made by Dr P. C. Bury of the Physics Department at the Victorian College of Pharmacy. More will be said about this later on.

Among the circuits given in October 1973 was one suggested for a power supply capable of 60 volts regulated at a maximum current of 2 amps. The design is quite a practical proposition, provided that components of adequate ratings are used throughout. This applies particularly to the transistors, with emphasis on the TT3055 / 3. Although we have not tried it in the particular role, it may be worth considering as an alternative supply for the Playmaster 132 Stereo Amplifier.

When considering the application of the above principles for a fully variable power supply, our thoughts were centred along an extension of the 60V / 2A circuit just mentioned. After careful consideration, a number of problems seemed to indicate that another approach would be worth investigating. Apart from the voltage problems associated with a 60 volt version, power dissipation was another one when the supply was to be used at very low output voltages. A dual positive and negative supply facility was not provided for, and herein lay a clue as to how our new supply should be approached. Two 30 volt 2 amp supplies would avoid most if not all of the obstacles.

By splitting the 60 volt supply into two 30 volt sections, the need for special high voltage transistors is avoided and readily available components may be used. When a low output voltage is required, the power dissipation in the 2N3055 transistor is reduced accordingly. When a balanced supply is required, the two units may be used to provide up to plus and minus 30 volts. There are applications where two different voltages are required separately and this need can also be met. Finally, the two units may be connected in series to give 60 volts at up to 2 amps.

Although the versatility of the power supply has been considerably extended by splitting, the cost has only been increased by a small margin, with the result that we have obtained many extra features for very little extra outlay.

We will assume that readers have already familiarised themselves with the principles involved, as referred to earlier, and we will take a look at the circuit diagram. There are two channels with a couple of differences between them, and these will be covered as we go along.

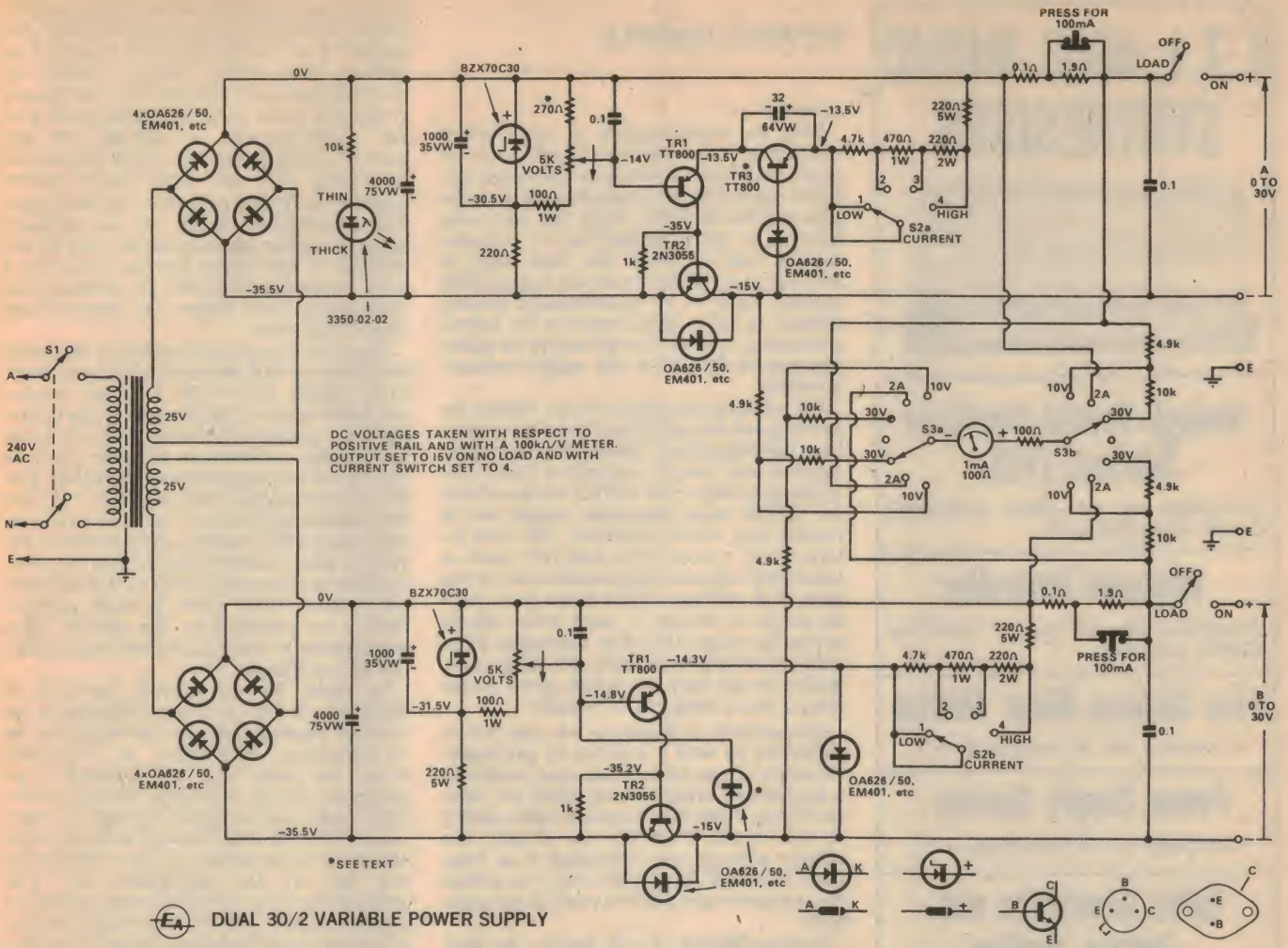
The power transformer has two secondary windings, each delivering 25 volts at 2 amps to its own channel. The original intention was to use the transformer as specified for the Playmaster 132 Stereo Amplifier. When it was decided to split the output into two separate and independent voltages, instead of a secondary rated at 50 volts and 2 amps, the secondary had to be split into two sections, each rated at 25 volts and 2 amps. We have arranged with Ferguson Transformers to modify the type PF3259 accordingly. Future production runs will incorporate the modification and users who wish to use the transformer as originally intended will simply have to connect the appropriate leads together and carry on as previously. For readers who wish to use the transformer in this power supply, it would be advisable to stipulate that you require the transformer with the two separate secondary windings.

The main filter in each case is a 4000uF 75VW electrolytic capacitor, following a bridge rectifier consisting of four OA626 / 50, or equivalent, silicon power diodes. We have used a LED as an indicator and this is connected in series with 10k ohms, directly across the 4000uF electrolytic on channel "A". The 10k resistor limits the current through the LED to a very low value but there is sufficient light output for indicator purposes. The resistor may be reduced in value to increase the light output, provided the LED ratings are not exceeded. We used a LED type 3350-02-02, made by McMurdo.

Reference voltage is stabilised at 30 volts with a type BZX70 / C30 zener diode, fed via a 220 ohm resistor. In channel "A", this is a ½ watt resistor but in channel "B", a 5 watt resistor is used. This is necessary because of the different situation under short-circuit output conditions, where a high current is passed through the 220 ohm resistor. Additional filtering is achieved with a 1000uF 35VW electrolytic across the zener diode.

A 5k 2W wire wound potentiometer is connected across the zener diode and the

This picture shows the neat and simple arrangement of the completed prototype.



EA DUAL 30/2 VARIABLE POWER SUPPLY

The above circuit features an alternative method of overload protection for each channel.

derived voltage is fed to the base of TR1, which sets the voltage at the output terminals. A 100 ohm 1W resistor is connected in series with the 5k potentiometer in each case. This is added to avoid excessive dissipation in the potentiometer for settings close to that end of its travel. The added resistor slightly restricts the available voltage to the base of TR1 but due to a small voltage rise across TR1, any loss is offset.

It may also be seen that there is a 270 ohm resistor at the other end of the potentiometer in channel "A". This is added to ensure reliable starting of this system at low voltage settings. It prevents the output voltage from being set to zero.

Transistor TR1 must be a PNP type, capable of withstanding 35 volts or so between collector and emitter, and it must also be capable of dissipating the power dictated by the settings of the voltage and current controls. A suitable transistor for this position is the TT800, or any similar type.

Transistor TR2 must be able to pass the maximum output current, it must also be able to dissipate the power resulting from the output current and the voltage drop between emitter and collector. In addition, it must also be able to withstand about 35 volts between collector and emitter. A logical choice here is the 2N3055, which is ideal. It may be seen that there is a silicon power diode between emitter and collector of TR2. This is added to protect TR2 from damage in the event of an external "same polarity" voltage being applied to the output terminals when the supply is switched off.

In channel "A", TR3 normally passes only a modest current, and as the transistor is saturated, the power dissipation is negligible. However, under short-circuit conditions, the full emitter voltage of TR1 will appear between collector and emitter of TR3. This can be anything up to about 30 volts, according to the setting of the voltage potentiometer. Again, a TT800 or similar is satisfactory.

The major difference between channels "A" and "B" is that TR3 and the 32uF electrolytic capacitor are dropped from channel "B" and replaced with a silicon power diode between TR1 base and TR2 collector. The latter approach is that suggested by Dr Bury, and I take this opportunity to quote him:

"This facility may be added to Nye's circuit by the much simpler process of adding a diode between the zener point and the output. This normally has a small reverse voltage across it and does not affect the operation of the circuit until current limiting occurs and the load voltage starts to to drop. It will then become conducting, diverting current from the zener diode, reducing the load voltage further. At low output current settings, the output is thus bootstrapped down until only the zener current flows through it. At high current settings, a current foldback action occurs, again reducing the output close to zero.

"Apart from simplicity, the advantages of this modification are that the circuit is not prone to oscillation and the circuit will bootstrap itself up into the conducting mode again, making it unnecessary to remove the load or the input voltage."

Unfortunately I am not able to agree with Dr Bury on the matter of oscillation, as I found both circuits had a tendency to oscillation. Hence my use of the 0.1uF capacitor on the base of TR1, regardless of the approach. This is a minor point however, and although I wish to be as objective as possible, I am of the opinion that both ideas have their merits. I have included both methods in the prototype so that I may evaluate them for myself, as well as presenting both ideas to readers.

As I see it, builders may make up the unit just as shown in the circuit and after trying both protective systems make a decision and alter the other channel over to the system of their choice. On the other hand, you may even elect to leave both systems in, which is what I have done so far.

Current limiting is controlled in both cases by a switched series of resistors between the positive rail and TR3 and/or TR1. A constantly variable resistor in the form of a wirewound potentiometer would be preferable to switched resistors, but due to the high power dissipation for relatively low resistance values on one hand, and the need to run to a relatively large resistance on the other hand, an ordinary wirewound potentiometer is not suitable. The next best approach is to select discrete resistors, with adequate dissipation ratings where necessary. This works out quite well in

POWER SUPPLY

practice.

With an understanding of the current limiting function of either circuit, it will be appreciated that the resistor values for any given current limiting will depend upon the gain of TR1 and TR2. With the inevitable spreads in these components, it becomes obvious that perhaps the best way of arriving at a resistor value for a particular current value is by experimental means. Indeed, to carry this theme to its logical conclusion, it would be necessary to select experimentally all of the eight resistors involved.

We selected the high and low values for one channel broadly along the above lines. The corresponding values for the other channel were simply duplicated. Even with a change in each case of TR2, we found that the results were consistent enough not to require any closer selection. The two intermediate values were selected more or less arbitrarily and the performance curves show that perhaps a little more care could be given to ensure a more even spread across the range. However, this can be dealt with on the merits of each individual case. Suffice to say that the values given on the circuit are a good place to start.

The subject of metering was one which presented us with a number of problems. Two meters, one for each channel, would be a convenient measure and make for easy switching. However, a considerable saving in cost results from the use of only one meter, although the switching is a little more involved. As may be seen, we settled for one meter and this has worked out quite well.

Having decided on one meter, the next question was just how best to make use of it. As the maximum voltage and current per channel would be 30 volts and 2 amps, it is obvious that these ranges should be provided for each channel. For convenient reading of lower voltages, we selected a 10 volt range as well. In addition, for low current readings, another range should also be added. This presented some rather complex switching problems and we finally added a 100mA range, not as separate positions on the metering switch, but by the addition of two press buttons. With the 2 amp range selected and by pressing the appropriate push button, the meter reads 100mA full scale.

Even after the general outline of metering had been decided, there were still problems to be solved. Due to the fact that readily available rotary awitches are of the shorting type, measures had to be taken to avoid undesirable interaction between circuits during the actual process of switching. For the voltage ranges, it was necessary to split the multiplying resistors into two halves in each case, with a resistor on each side of the switch. Also, to avoid tying the two channels together momentarily when switching from one channel to the other, a blank position had to be provided on the switch. This necessitates a 7-position switch rather than one of 6-positions.

So much for the overall approach to metering. A few comments relating to the resistor requirements for metering may be of assistance. Once again, to keep costs down, we found that the ordinary 5 pc preferred range of Philips resistors were quite good and accurate enough in most cases. The 100 ohm resistor in series with the meter is an ordinary 5 per cent type, as are the two 10k multipliers. The 4.9k multipliers were obtained by paralleling a 5.6k and a 39k. The 0.1 ohm shunt was obtained by paralleling two 0.22 and a one ohm

LIST OF COMPONENT PARTS

1 Case, 30.5cm wide x 16.5cm high x 11.5cm deep
1 Front panel
1 Handle for case (optional)
4 Rubber feet
4 Knobs
3 Rubber grommets
2 heat sinks, Miniwatt 35D4CB
1 Plastic terminal block, 5-way
1 Transformer, 240V primary, 2 x 25V 2A secondaries
1 Meter, 0-1mA, 100 ohms, 7.5cm x 6.5cm
2 Miniature tag strips, 17 prs tags
6 Terminals, 2-red, 4-black
2 Miniature toggle switches, DPDT
2 Miniature push-button switches, SPDT
1 Rotary switch, 2-pole, 4-position
1 Rotary switch, 1-pole, 7-position, 2 wafers
13 Diodes, OA626 / 50, EM401 or similar
1 LED, McMurdo 3350-02-02, or similar
2 Zener diodes, BZX70 / C30
2 Transistors, 2N3055
3 Transistors, TT800, AY9139
2 Heat sinks for TT800, AY9139

RESISTORS (½W unless stated otherwise)
4 0.22 ohm
2 1 ohm
2 2.2 ohms
2 15 ohms
3 100 ohms 1W
1 220 ohms
2 220 ohms 2W (or 2 x 470 ohms 1W in parallel)
3 220 ohms 5W
1 270 ohms
2 470 ohms 1W
2 1k
2 4.7k
2 Potentiometers, 5k 2W, wire wound
4 5.6k
5 10k
4 39k

CAPACITORS
4 0.1uF 160V polycarbonate
1 32uF 64VW electrolytic
2 1000uF 35VW electrolytics
2 4000uF 75VW electrolytics

MISCELLANEOUS
Hookup wire, solder, solder lugs, 3-core flex and plug, cable clamp, screws, nuts.

Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used, providing they are physically compatible. Components with lower ratings may also be used in some cases if available, providing ratings are not exceeded.

together. The 1.9 ohm shunt was arrived at by paralleling 2.2 ohms with 15 ohms.

If you have no means of cross checking the meter readings given for each of the ranges, then those given with the resistors quoted should be fairly close in most cases. On the other hand, if you have access to a meter of known accuracy, you may check the readings given by the power supply meter and make any corrections where this may be found necessary or desirable.

The complete unit is built into the same size case as that used for the AF Signal Generator, described in September, 1968. The measurements are 30.5cm wide x 16.5cm high x 11.5cm deep. This accommodates the components without any crowding, or undue waste of available space.

Perhaps the best place to start with the construction is with the sub-assemblies.

The small components are mainly accommodated on two miniature tag strips, one for each channel. A complete wiring diagram is given for the channel "A" strip. The strip for channel "B" will be the same except that the 10k resistor for the LED will be eliminated. Also, TR3 and the 32uF electrolytic are deleted and the extra silicon diode is added. These changes can be made quite readily. When wiring these strips, leads of sufficient length should be added where indicated, for external connections.

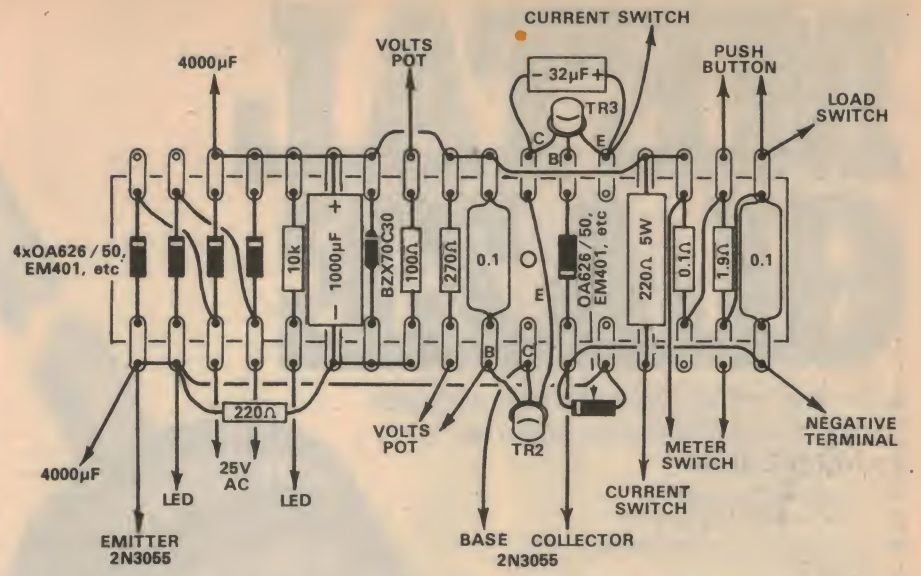
Each 2N3055 is mounted on a Miniwatt type 35D4CB heat sink. Four holes must be drilled for each transistor and they must be accurately located. Great care must be taken to achieve this. The job is made easier if you have a drilling template in the form of the plate from a TO-3 dud transistor case. Four more holes must also be provided to mount each heat sink on the back of the cabinet.

Each transistor is mounted on its heat sink by means of the hardware provided, with a smear of silicone grease on each side of the mica insulator applied before assembly. A piece of spaghetti tubing should also be placed over each of the base and emitter leads, such that about 3mm are left bare for soldering. A solder lug should also be provided under one of the mounting screws for the collector connection. We mounted the 1k resistor directly across the base and emitter leads and then provided three leads of different colours, of sufficient length to reach the appropriate terminals inside the cabinet.

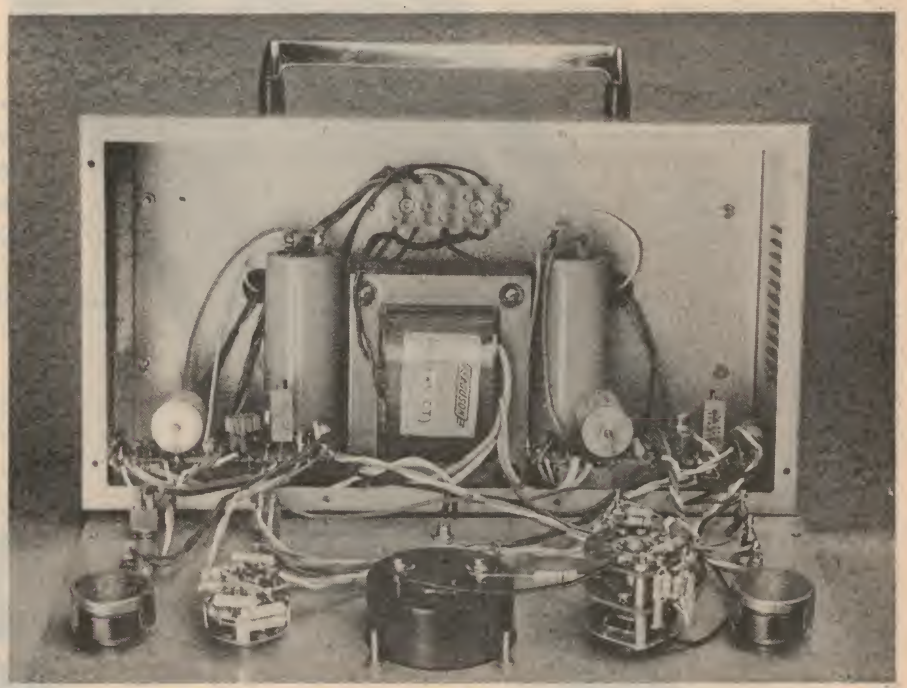
Before attempting assembly of the front panel, it makes the job easier if the current and metering switches are wired before they are mounted. This done, the components may now be mounted on the panel. There is quite a bit of wiring which can be done between the panel items.

Assembly and wiring of the cabinet will be made somewhat easier if it is approached in a sequence designed to avoid any backtracking. If you are going to fit a handle to the case, this may be done first. We used one which is designed for use with furniture, and any similar handle would be all right here. After the handle, the mains terminating strip is next, followed by the mains cord. This should be clamped just inside, after passing through a grommet. The mains leads are terminated on the strip.

The heat sinks, with their transistors and leads, should be fitted next, with the leads passed through a rubber grommet in each instance. The power transformer is next, followed by the two 4000uF electrolytics. The clamps on the electrolytics should be



Above is the wiring diagram for the channel "A" tag strip. Modifications to this strip for channel "B" are discussed in detail in the text. Below is an interior view of the instrument showing the general disposition of major components.



adjusted before they are finally screwed up. The two tagstrip assemblies are mounted with two ⅛in Whitworth screws, 1in long. Three nuts are used on each screw to make the screws function as stand-offs, so that the strips clear the bottom of the case by⅝in or so.

At this stage, with one exception, all interconnecting wiring may be completed. The exception we suggest is the 25VAC leads from the transformer to channel "B" tag strip assembly. These leads should be insulated with tape for the time being and placed out of harm's way.

Before doing the interconnecting wiring between the front panel and the rest of the cabinet, to keep leads reasonably short and allow any servicing which may be necessary in the future, lay the front panel face down and with its bottom edge just touching the front face of the cabinet. After finishing this wiring, to make it a little tidier, we bound leads together at obvious points.

A few points which we observed during wiring are worthy of special mention. The electrostatic shield of the transformer is terminated on the earth screw of the mains terminating strip. A lead is also taken from this point, to a solder lug under the right front screw holding the transformer. From this lug, a lead is run to the two "earth" terminals on the front panel.

Resistors rated over 1 watt have been kept as clear as possible of adjacent components. The four leads terminated on the mains on / off switch have been covered with a short length of spaghetti and pushed over the soldered joint to ensure safety against accidental contact. The polarity of the LED must be observed and on the one we used, the thin lead is positive.

At this stage, the wiring is virtually complete and the next step is to make a thorough check of all wiring, making sure that switching is correct and all polarities

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IRC, the developer of Metal Glaze, now offers a new, low-cost, moulded Metal Glaze resistor, value engineered for optimum precision and reliability.

The thick-film Metal Glaze resistance element, 100 times thicker than conventional films, defies catastrophic failure, withstands high temperatures and high overloads, and is impervious to environmental extremes. Its fully insulated moulded body resists solvents, corrosion and mechanical stresses and has a dielectric strength of 500 VRMS.

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have been correctly observed. Satisfied that all is well, channel "A" may be switched on and checked for correct operation.

Set the "volts adjust" potentiometer to maximum, the "current" switch to "low" (or 1) and the "metering" switch to 30V on "A". Switch on and the meter should indicate a little over 30 volts. Wind the volts adjust potentiometer up and down and the voltage should rise and fall accordingly. At the lowest current switch setting, very low voltages may be a little hard to get, with the supply tending to drop out, but this will disappear on higher current switch settings. Even on this setting, the supply can be easily reset by a rapid clockwise flick of the volts adjust pot.

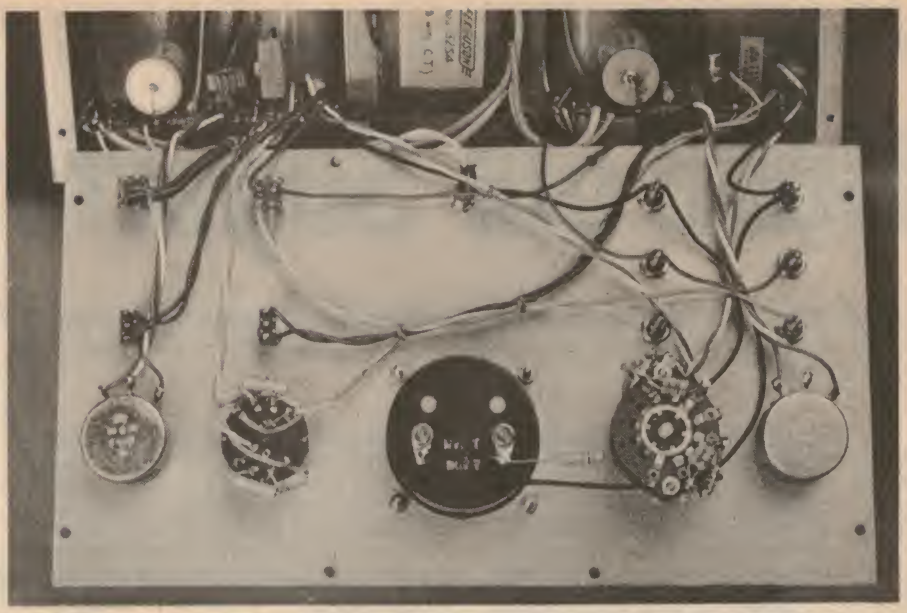
Reset the volts adjust potentiometer to maximum and with the load switch on, short circuit the channel A output terminals. The voltmeter will indicate zero and will stay there after the short circuit has been removed. The output voltage can be restored by switching the mains off and leaving it for a minute or so and switching on again. A quicker way is to turn the load switch off and turn the volts adjust potentiometer down to half way or so, then quickly advance it again. At this stage, testing on channel A may be stopped and the 25VAC leads which were left unconnected, may be connected to channel B.

The procedure for channel A may now be repeated for channel B. However, there will be some differences. Initially the voltmeter should show a little over 30 volts with the volts adjust potentiometer fully advanced. Winding this control up and down will result also in the voltage rising and falling. Instead of the voltage only falling to a minimum of about two volts, it should go right to zero, with no signs of the erratic behaviour at low voltage settings, with the current switch still set to 1. Also, when channel B output terminals are short circuited, the voltage will fall to zero on the meter and immediately rise again when the short circuit is removed.

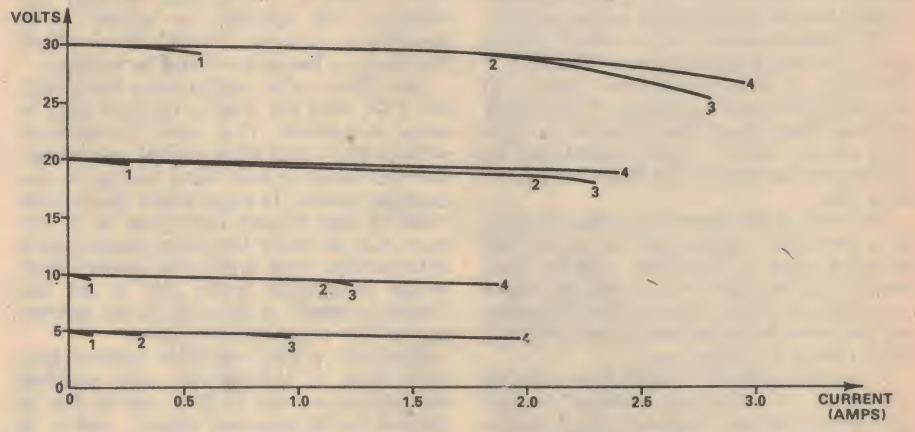
Tests thus far should indicate that both circuits are functioning normally and the only other detail to be determined is the current cut-off points for each of the current switch positions 1 to 4, for each channel. Reference to the curves will give a good idea what to expect.

Unless you have a high power rated variable resistor, perhaps the best way to check the rest of the current ranges would be to have a handful of various resistors of suitable values and high enough power ratings, such that combinations of these resistors may be used to load the output and check the voltage roll-off points, prior to cutoff. This rather lengthy series of tests need not be undertaken unless you really wish to know just where cutoff occurs under any set of conditions. Your unit will probably behave in a manner similar to that shown by the curves, but the exact point of cutoff may differ somewhat, depending upon the respective transistor gains.

Even if you do not go through the complete test procedure, it would be wise to check progressively the current cutoff of each channel, by shorting out each in turn. In each case, the voltage will fall to zero; if all is well, channel "A" current will fall to zero and will remain in this condition after the short circuit is removed, while channel "B" current will fall to a low value and immediately the short circuit is removed, the voltage will return to normal.



The photograph above shows the wiring details of the front panel. The curves below are a guide to the performance of the prototype.



A final test is a short circuit test with both channels connected in series. The negative terminal of one channel is connected to the positive terminal of the other channel. Although it is not essential, the voltages should be set so that they are equal. Shorting out the system should result in one of the channels opening up and becoming a high impedance, thereby protecting itself and the other channel as well.

With regard to the performance of our new supply system, the voltage regulation is not up to the standard of rather more sophisticated designs but for most purposes, the regulation should be adequate. Another point which should be brought out, is the condition where a high current is drawn at low voltage settings. About the worst case would be when the output voltage is set to 5 volts and the load draws 2 amps. This means that there will be approximately 35 — 5 volts across the 2N3055 and the power to be dissipated will be about 30 x 2, which is 60 watts. This is a lot of power and while the 2N3055 would stand up to it for a short time, damage may result from prolonged operation under these conditions. In short, it would be wise to watch this sort of situation closely.

From the above, it would seem that the supply has been under designed. On the other hand, when the output voltage is set to 30 volts, and 2 amps are drawn by the load, this means that the dissipation in the 2N3055 will be about 10 watts. Perhaps one could say that the unit is over designed for this condition. As is the case with many situations, a compromise must be struck and we feel that the compromise here is a reasonable one.

The uses to which the dual supply may be put are many and varied. There will be many cases where just one voltage is required. On the other hand, in cases such as modern solid state audio amplifiers, a low voltage will be needed for the low level stages and a higher voltage will be required for the power amplifier stage. There is the situation where an audio power amplifier stage will need a balanced power supply, say plus and minus 20 volts. Then there is the power amplifier which needs a 60 volt supply at a couple of amps.

Possibly there is no better way to get to understand the behaviour of each channel of the power supply than to experiment and "have a play". It seems to be virtually foolproof against overload and short circuit. Also, in the event of a charged capacitor being connected across either channel in the correct polarity and with the mains switch off, no damage will be done as the 2N3055 is protected against this treatment by a diode. We also charged a 2000uF capacitor to 30 volts and connected it in reverse polarity and with the mains switch off. This test was applied to each channel and again no ill effects were observed.

Elementary Electronics

Leave crystal sets behind —

Build our Superfet.

by Ross Tester

Would you like a portable, local broadcast station receiver that is simple to build, and won't cost you the earth? Try our Superfet — you won't be disappointed!

The Superfet is a two stage regenerative receiver, with a FET front end and a bipolar transistor audio amplifier. Actually, the audio amplifier is that published a few months ago as an amplifier for crystal sets.

This amplifier uses a valve-type speaker transformer to match into modern 8 ohm dynamic headphones. While a crystal earpiece could be used, the performance obtainable is nowhere near as good as that from low impedance "hi-fi" types, which we understand are available for as low as $3.75.

The Superfet is built into a small plastic case, measuring approximately 160 x 90 x 70 (WxHxD). It is available from your local parts supplier for around $1.50. If your parts supplier doesn't have them in stock, tell him they are a "Jabel" brand, distributed by Watkin Wynne Pty Ltd. He should be able to help you.

But back to the receiver proper. Instead of a long-wire aerial and an earth, the Superfet uses a loopstick (ferrite rod) aerial. This enables it to be used anywhere — nothing is more annoying than having a set tied to an aerial and earth unless there is good reason for doing so.

In parallel with the loopstick is a tuning capacitor. A standard 10-415pF single section type is used. To keep the cost down, you may be able to salvage one from an old set. However, it is likely that it will be physically larger than ours (though it would have the same capacitance) and a double gang. If so, the layout we have used will probably have to be changed. Also, check that the plates do not touch anywhere over the travel — you can do this with an ohmmeter.

Immediately following the tuned circuit (formed by the loopstick and capacitor) comes a device which may be new to many readers — a FET (type MPF102). FET is an abbreviation for Field Effect Transistor.

FETs are three element devices — they have a gate, a source and a drain; equivalent to the valve grid, cathode and anode, respectively. However, they have one rather different characteristic — most junction FETs are not polarised. In other words, the drain can be used as the source and vice versa. This is fortunate if you happen to make a mistake wiring them up — providing the gate is connected correctly, the other two connections can be interchanged!

The FET is the nearest thing to a solid state equivalent of a valve so far developed, and has many similar characteristics. In fact, some FETs have been produced which are plug-in replacements for certain types of valve. As with most solid state devices, they are much more efficient than valves, requiring no heater current.

As the term "field effect" implies, the FET controls the current through its drain and source by an electric field or, in simpler terms, by means of the voltage applied between its control electrode — the gate — and its source. In this respect it is similar to a valve which controls the current through its anode and cathode by the voltage applied between its control electrode — the grid — and its cathode.

And it is unlike the bipolar transistor, which controls the current through the collector and emitter by means of a (smaller) current through its control electrode — the base — and its emitter.

Also, like a valve, and unlike a transistor, the FET does not need a forward bias in order to conduct. If a valve is operated without bias it will allow a quite substantial current to flow unless this is limited by the external circuit. In some cases the current could be high enough to damage it. In any case, it is normally necessary to provide a reverse bias, both to keep the current flow within acceptable limits and to set the "working point" of the grid on the correct part of the characteristic curve.

Similarly, a FET operated without bias will allow a substantial and possibly destructive current to flow, unless this is limited by the external circuit. And it is necessary to provide a reverse bias to control this current and also set the "working point".

The transistor, on the other hand, will not pass any significant current in the absence of bias. It is necessary to provide a forward bias, first to establish a flow of current, and then to set the "working point".

Since the FET, like the valve, requires only voltage on its control electrode, and passes negligible current through it, it has a similar high input resistance. The bipolar transistor, on the other hand, passes significant current through its control electrode and has a low input resistance.

Regardless of these differences, all three devices have some characteristics in common. All have a current value beyond which it is either impossible or unsafe to go. All have "cut-off" condition where current ceases to flow or is reduced to a minimum value. And, in using all three as an amplifier, it is normal to set the control electrode "working point" so that the standing current is approximately midway between these two extremes.

You may have noticed that there are no bias components in the gate circuit — where with a transistor there would be at least one, and possibly two resistors. In this case, the bias is generated in the source circuit by the 10k resistor and the 1uF capacitor; a system virtually identical with one commonly used for valves. Current through the source resistor generates a voltage across this resistor, positive at the source end. Since the gate is connected to the other end of this resistor (via the tuning coil) the gate is negative with respect to the source by the voltage developed across the resistor.

In the drain circuit, there is a 1k pot. This pot controls the "regeneration" of the set. You may remember last month we talked about positive and negative feedback. Another name for positive feedback, where part of the output is fed back to the input in phase, is regeneration. Can you see the feedback path?

If you said from the 1k pot, through the smaller winding and back through the tuned winding, you are correct. Actually, the small winding on the loopstick is known as the feedback winding. The 1k pot controls the amount of signal which feedback winding receives. If the pot is very close to the top of the travel, very little of the signal flows through the winding — but if the pot is near the bottom of the travel, a lot of the signal finds it easier to travel through the feedback winding than through the 1k resistance of the pot.

The pot also doubles as the on / off switch, and for this reason you should specify a switch pot when buying the parts. This saves the added expense of a completely separate switch — although there is nothing to stop this arrangement if it is desired.

A 4.7k resistor from the positive supply to the top of the pot is the load resistor for the FET. The audio signal is developed across this load.

From the top of the pot is a .01uF bypass capacitor. Its purpose is to provide a path for RF signals to return to the tuned circuit via the negative rail, rather than via the audio circuit. If RF does manage to find its way into the audio section, it makes the whole circuit likely to burst into violent oscillation. It may also reduce the overall performance of the set, because the RF stages do not have a proper return path.

A 1uF capacitor couples the audio information developed across the 4.7k load resistor to the audio amplifier. We have already explained this circuitry in a previous issue so we will not take time to do so again. Suffice it to say that the audio is amplified to a level which permits good, loud signals in the headphones.

We can already hear the question in many reader's minds: "Where is the detector?" What, you hadn't missed it? Well, look back over the circuit again. Can you see it?

We must admit that it is not immediately obvious. Detection takes place in the FET, due to the amount of bias used. We have deliberately biased it onto the curved portion of its characteristic and it is this curvature which causes one half of the signal to be amplified more than the other. The system is analogous to the old valve type "anode bend detector" so perhaps it should be called a "drain bend detector".

So that's the circuit — nothing to it, is there? Not really, but when you build this little set, don't be surprised at the performance. It quite belies its simplicity.

Construction of the Superfet may begin with the construction of the loopstick (tuned winding only). Ferrite rod is sold in 200mm lengths — and as we need only 100mm, it must be divided. Do not throw away the excess — it will come in handy in the future. Cut the ferrite as you would cut glass. File a nick right around the ferrite, then tap it on the edge of a desk, etc. Take care not to drop it, as ferrite is brittle and will break easily.

Do not attempt to cut ferrite rod with a saw. If you do, it will almost certainly shatter, rendering it useless.

Wind a layer of insulation tape over the ferrite to protect the wire, then anchor the wire about 2cm from one end (leave about 10cm wire over) and wind on 60 turns, tightly and close together. Anchor the winding with insulation tape. No taps are required.

Once again, leave 10cm of wire for connection, then cover the winding with a layer of insulation tape for protection. Two small brackets are used to mount the ferrite rod — details of which are given. These screw to the rear of the case — but leave this for the moment.

Next the tagboard can be wired according to the circuit and layout. Note that two of the components are underneath the board — a capacitor and a resistor — this allows a much neater and logical layout than would have otherwise been possible. Try to stick to our layout — it is one which is likely to give the least trouble. Regenerative circuits can give trouble if the layout is poor.

We presume most readers will be using the speaker transformer and low impedance headphone system which we have been using recently — high impedance headphones are not only hard to buy, but are now quite expensive — more so than a set of low impedance hifi headphones which you will also be able to use with your stereo amplifier.

If this is not the case, and you already have a set of high impedance 'phones which you wish to use, simply ignore the transformer and connect the earphones where the primary of the transformer would be (this can also be done via a plug and socket on the front panel).

If you use a transformer, it can be the first component placed in the box. It is placed against one side of the box, hanging from the top. Our holes were drilled 23mm from the outside edge, and were 52mm apart, suiting a Ferguson E5K15 transformer. The mounting feet on this transformer are just too long to fit sideways into this box — so we filed 2mm from one end and the transformer fitted nicely. All holes in the plastic case are countersunk from the outside, to enable countersunk head ⅛in whit. screws to be used. These look much neater than the usual round head screws — and also make sure that the set will not scratch any surface on which it is put. If countersunk head screws are hard to come by, try at least to use four on the underside for the above reason.

The tagstrip is mounted alongside the transformer, our mounting holes being 65mm from the edge. The 9 lug tagstrip fits well into the space. The wires from the tagstrip are left disconnected for the moment. The battery occupies the opposite corner to the transformer — again hanging from the "roof". A simple battery bracket made from tinplate or thin aluminium holds the battery, the bracket being secured with one screw and nut.

The brackets for the ferrite rod are screwed to the back of the case, so the ferrite rod occupies the space behind the transformer and the tuning capacitor, which is the last item fitted. The ferrite rod is held on the bracket by two grommets which are slid onto either end of the rod. The photograph shows this more clearly. The length between mounting brackets need not be exact, as the grommets can be moved to fit.

Now the tuning capacitor can be fitted. It is mounted on the bottom of the case by four screws, each fitted with 3 nuts — one to hold the screw in place, one to act as a spacer, and another to hold the capacitor in position. The capacitor is mounted so the shaft is on the horizontal centre line of the case, approximately 40mm from the right inside edge.

With the capacitor mounted, all leads can now be cut to their correct length and connected. First, connect the leads from the tagboard to the capacitor, then the flying leads from the tuned winding to the same points. The battery, transformer, potentiometer and output socket can also be connected at this time.

Make sure you get the leads to the potentiometer correct. If an error is made, the tuned winding will, at some point, be adversely affected by a short across the feedback winding. This alters the "Q" (quality) of the coil, and results in very poor performance.

The wiring of the headphone socket also warrants a special mention. It is important that the socket be wired so that both phones receive signal. To do this (and also to present the correct impedance to the output transformer) we wire the phones in series. Simply use the socket tags which connect to the tip and ring of the plug. Ignore the tag which connects to the main body of the plug.

So far, we have not mentioned the feedback winding. This is deliberatly left until last in order to get it right. Once you are sure all wiring is correct, plug in your

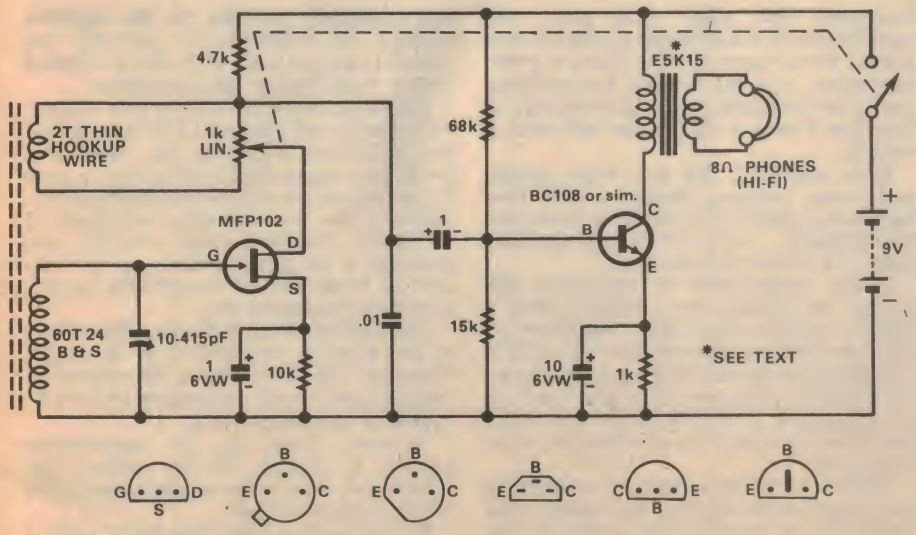
You will need these parts . . .

SEMICONDUCTORS:
- *1 MPF102 FET*
- *1 BC108 or similar transistor*

RESISTORS: ½W 5 or 10%
- *1 1k*
- *1 4.7k*
- *1 10k*
- *1 15k*
- *1 68k*
- *1 1k linear switchpot*

CAPACITORS:
- *2 1uF 6VW electrolytic*
- *1 10uF 6VW electrolytic*
- *1 .01 low voltage ceramic*
- *1 10-415pF single section tuning capacitor (Roblan)*

MISC:
- *1 plastic instrument case (Jaael approx 160x90x70mm)*
- *1 aluminium front panel to suit*
- *1 100mm length of ⅜in ferrite rod*
- *1 speaker transformer 5k to 15 ohms (Ferguson E5K15 — see text)*
- *1 stereo headphone socket*
- *1 9-lug section of tagstrip*
- *2 rubber grommets*
- *24B&S enamelled copper wire*
- *Thin hookup wire*
- *9V battery (Eveready 216)*
- *Scrap aluminium for brackets*
- *"Letraset" for marking front panel if required*
- *Countersunk head ⅛in Whit. screws and nuts to suit*



The essential simplicity of the Superfet is demonstrated by the circuit diagram. Each of the component functions is explained in the text. Take care with transistor lead configurations.

earphones and turn on.

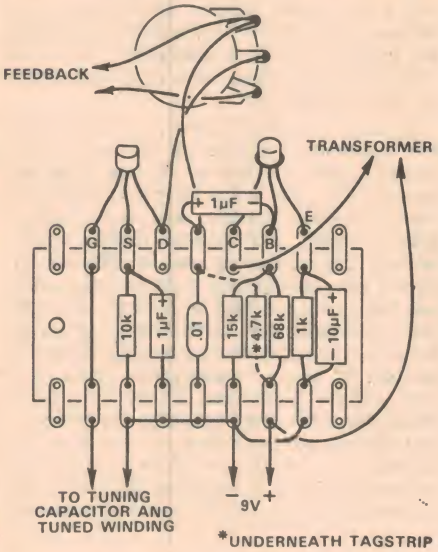
You should hear noise in the headphones — and if you are in a strong signal area, you may be able to pick up some broadcast stations. If so, you are almost finished. If not, re-check your wiring and battery.

If you are not in a strong signal area, it might be wise to place the set near an aerial lead for the final adjustment — there should be no need to connect the aerial to the set.

Tune slowly over the band until you can hear a station. It may take a while to find one with the set in this state, but persevere. When you have found one, be careful not to move the tuning capacitor.

Solder a short length (say 20cm) of thin insulated hookup wire to one of the two outside pot terminals. Take the other end and pass it twice around the tuned winding on the ferrite rod — no more. Pull it reasonably tight, and anchor it in place with a length of insulation tape. Cut it to the required length and solder it to the other outside lug on the pot. This is the regeneration winding.

Here it may be appropriate to make a few comments about the behaviour of regenerative circuits. As regeneration is increased, the stage first goes into oscillation at a radio frequency determined mainly by the tuned circuit. Since it is RF oscillation, it is not audible, but you may hear a faint rushing noise. Alternatively, if you tune across a station you will hear a whistle.



More precisely, this is a high pitched audio note, dropping sharply to zero, then increasing again as the station is tuned out. The midpoint — or where there is no audio note — is called the zero beat.

If the regeneration is advanced still further the system may suddenly emit a harsh raspberry-like note, regardless of whether a station is tuned in or not. This is caused by the system choking up, going out of oscillation, then coming back in again, at an audio rate. It is this audio rate which produces the note. The condition is called squegging.

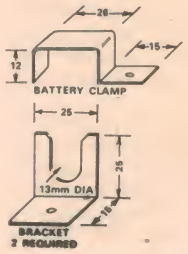
When you turn the set back on after fitting the regeneration winding you should hear one or other of the following results: (1) The station may be louder, and perhaps distorted, or with a whistle superimposed on it, or the set may be squegging. (2) The original station may be weaker.

Condition (1) indicates that you are on the right track. If the set is squegging, reducing the feedback by means of the pot should bring it out of this condition, possibly into a whistling condition, then into a clear signal.

If condition (2) is experienced, reverse the connections to the feedback winding. This should produce conditions described in (1). If you now find that the pot control works in reverse (anti-clockwise to increase regeneration) transfer the lead from the tag strip to the outer pot lug to the other outer lug. Leave the centre lug connection as is.

If you find it impossible to get any joy out of the set either way, try another turn on the feedback winding (but only try this if you can't get results any other way — too much feedback may cause havoc). You may also try moving the feedback winding up and down the ferrite rod to change the coupling. Over the tuned winding gives the strongest coupling.

With the electrical side of the Superfet completed, all that remains is the front panel, plus a few pointers on how to use it. The front panel must be made from metal, **and preferably earthed (to the negative** supply). As aluminium is probably the easiest to get and work with, this is a logical choice. Ours was of 22g aluminium.



Left — wiring layout and bracket diagrams. Below — the interior showing placement of all components.

The panel should be exactly 85 x 158mm. The corners are rounded to fit the case. If the aluminium is cut this size, there is a pretty fair chance that it will be such a good fit that no screws will be needed to hold it in place — this was the case with ours. If necessary, however, four dimples are provided in the plastic case (one per corner) to be drilled out to suit self tapping screws (say number 4's).

The position of the handspan dial is more or less fixed by the position of the tuning capacitor. This should be on the centreline, but if it is not, can be adjusted up or down by means of the spacing nuts.

To even things up, the regeneration control is placed on the centre line, equidistant in from the opposite side as the tuning capacitor knob.

On the inside of your front panel, mark a centre line. By careful measuring, determine the distance from the inside edge of

(Continued opposite)

Elementary Electronics Ideas Worth Trying

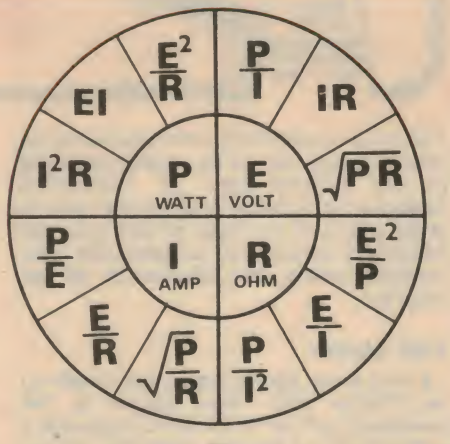
Remembering Formulas

The various formulas involving combinations of voltage, current, resistance and power, somewhat loosely referred to as "Ohm's law," can sometimes tax the beginner's memory. Various novel presentations have been published from time to time, aimed at either reducing the number of combinations to be remembered, or combining them in ready reference form.

One of our readers suggested that it is time we presented something along these lines again, for the benefit of new readers. And to set the ball rolling he has submitted the accompanying diagram.

The diagram is divided into four quadrants; each representing one of the four parameters we wish to solve, together with the three appropriate formulas. Thus E, in the top right quadrant, may be found from P divided by I, by I multiplied by R, or by the square root of P multiplied by R.

In addition, the layout has been so arranged that if we ignore (or cover) the P quadrant we are left with a very popular combination, used many times before, which functions as memory tickler for the three remaining parameter formulas.



$$\frac{E}{I \times R}$$

The combination is easily remembered as E over IR. If we now cover the wanted parameter, the remaining combination tells us how to find it. Thus, if we wish to solve for E, covering E leaves I multiplied by R, the required combination.

(Mr S. Hoy, Villa 7, 19 Banksia Court, Noble Park, Victoria, 3174.)

This Is Your Page

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If you feel a photograph or diagram would help, by all means submit it. We will decide whether or not it is suitable for publication. If possible, submit both print and negative. Diagrams which are good enough for us to use directly are preferred, but a clear sketch from which our draughtsman can work will be accepted.

Send your ideas (preferably typed or printed) to: Electronics Australia, Ideas Worth Trying, PO Box 157, Beaconsfield 2014. We will acknowledge receipt and — who knows — you may find your idea in print and a cheque in the mail.

the box to the centre of the pot shaft, and mark a point on the centre line. Mark a point the same distance in the opposite side. After re-checking, drill these holes to ⅜in. While the shaft of the tuning capacitor is only ¼in, drilling a bigger hole means you have some margin for error — and in nine cases out of ten, there will be some error.

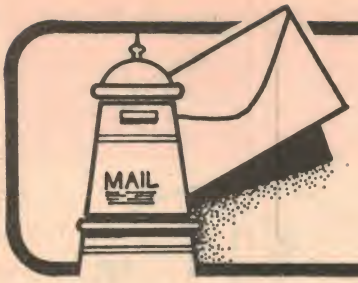
A standard pot requires a ⅜in hole for mounting. The headphone socket also requires a ⅜in hole, and this is located in the bottom left hand corner. It is located as close as possible to the corner — our hole being drilled 17mm in from each edge.

De-burr all holes with a larger drill, and try the lid out for size. If everything fits, you can take the lid off and mark it as you desire. We used "Letraset" for all marking (name stations and functions) after we dressed the surface by rubbing it with a wire brush. After lettering, a fine coat of clear enamel was applied to protect the surface.

Now for the driving instructions — not that you need a driver's licence (but you do need a broadcast listener's licence!) — but a regenerative set may be a little tricky while you are getting used to it. The easiest way to tune a set of this type is to "tune the whistles". Turn up the regeneration control until the set begins to squegg, then back it off until this ceases. Then tune a station by listening for the whistle and adjusting for zero beat. After adjusting for zero beat, back the regeneration control off slightly until the station becomes clear and no beat note can occur.

You will note that a different amount of regeneration is required for the top end of the band than for the bottom end — this is quite normal. It is quite possible for the set to go into regeneration without you even realising it. In fact, the only way you can tell is if the whistles are heard each side of the station. But for the most part, maximum volume is obtained with the set just on the verge of breaking into oscillation.

We hope you are as happy as we are with the performance of this little set. Considering the number of parts involved, it can truly be called a "gutless wonder" but the performance leaves nothing to be desired.



Letters to the editor

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.

VLP player

I very much appreciated your article on the Philips VLP video player in the November 1973 issue. However, although I understand the general operation of the system, one thing has eluded me. In spite of reading the article several times, I could not discover by what means the ever-increasing surface velocity (inside to outside playing) could contain one frame in one revolution, without altering the vital distance between the "pits."

If the speed is kept strictly to 25rps, as explained in the article, the increase in diameter from 5 to 12 inches must cause the pit spacing to vary, surely.

Incidentally the new letter pages are a long overdue reform. Keep up the good work.

S. Hoy (Noble Park, Victoria).

COMMENT: Our reading of the article is that the luminance information is encoded on the VLP disc as a modulation of the pit repetition frequency. Thus for a constant disc rotation speed, the absolute pit spacing would vary with the diameter. Presumably it would in theory be possible to maintain a constant absolute pit spacing and fit more information onto the disc, but this would destroy the very convenient one-picture-per-rev relationship offered by the system as it stands. We're glad you find this column a worthwhile addition.

TV programs

I have been a subscriber to your magazine under its various titles throughout its entire existence and I have followed my interest in electronics since before the commencement of commercial broadcasting in this country.

The character and composition of your publication are excellent and on that I congratulate you and those responsible. I am disappointed, however, to observe that in your December issue you choose to involve yourself in the entertainment and other aspects of television programming in Australia — a field which, with the greatest of respect, does not other than technically concern you or your publication.

I am compelled to say that matters of public choice, taste and enjoyment are fields outside those in which your magazine is involved. There is, in Australia, a large number of dedicated amateurs obsessed with the desire to impose their personal and frequently inexpert views on people whose life work has been to become sufficiently skilled to be able to evaluate and anticipate public taste. If television programming does not meet the needs of the viewing public no amount of regulation or technical opinion will compel the viewers to watch. Just as your magazine needs circulation so television needs audience to be successful and it is the programs which determine this.

Douglas W. Watt,
Managing Director, TelePrograms Pty Ltd, King St, Sydney.

COMMENT: Your reaction is understandable, but your assumptions are not necessarily valid. It is very much a moot point whether magazines such as ours should restrict themselves purely to technical matters, for example. In fact the growing pressure on scientists and technologists to consider the full social implications of their work suggests that we and other magazines have a responsibility to all concerned to adopt a wider outlook. While we may not claim expertise as program producers, most of us — both magazine staff and readers — can claim some expertise as program consumers, and it is at least arguable that this is the more relevant qualification. One does not have to be a chicken to know a bad egg.

Pioneer 10 spacecraft.

I read with great interest the article in the January issue about the Pioneer 10 Jupiter probe. Some of the times and figures and distances are quite fascinating to contemplate.

However, what completely beats all my contemplative powers is the last bit: "The spacecraft carries a plaque which is intended to inform any intelligent beings . . . exactly where the spacecraft came from and who sent it."

Now, my question is — and perhaps you can let us all in on this — how was the plaque written?

O. A. Johnstone (Inglewood, Qld).

COMMENT: The message is in the form of symbols, using a diagram of the spacecraft itself as a starting point. There are drawings of a man and woman to the same scale, together with other diagrams intended to provide clues as to the location of the Earth and our solar system. Details were published in many newspapers when Pioneer 10 was launched.

Digital clock

My friend and I recently completed our third digital clock to your September 1973 design. Two of the clocks exhibited the same fault.

Briefly the time keeping was excellent and the neon display very attractive. But from 10.00.00 till about 12.50.00 the display was far from satisfactory, with one or two segments going out right across the whole display. To further confound matters the presentation of any instant in time was predictable and we painstakingly logged all segments over a fair time. The logging

confirmed the predictability of the fault and suggested that the IC itself was at fault.

NS Electronics (through their agents — PrePak) were very co-operative and submitted the IC to tests. It transpired that the specially selected transistor (with the green dot!) needs to work to very close tolerances. Several "green dots" were tried until two were found that removed the problem.

Statistically we had two out of three clock kits with less than effective "green dot" transistors. Two other "green dots" out of four were unsuitable. It would appear that perhaps 50pc of constructors will have the problem. We write to warn other readers, since we literally tore the first clock to bits trying to trace the problem.

NS Electronics and PrePak were most helpful at all times and our thanks go to them for their final assistance. The completed clocks are a pleasure to behold and the kit was a delight to build. May we expect to see similar projects in the future.

M. S. Rychter (Dover Heights, NSW).

Value for money?

I do not agree with your reply to the readers complaining about the dropping of Listening to the World. You replied that space did not permit the continuation of the section. Yet I noticed that this same issue was smaller by 16 pages than the other issues of E-A that I have purchased recently, and the magazine was made up of almost 50 per cent advertisements.

J. M. (Glen Innes, NSW)

COMMENT: Contrary to what you and other readers seem to believe, the size of the magazine is not determined by arbitrary whim. It is very much set by such mundane factors as printing costs and advertising revenue, which no magazine can ignore if it is to survive. There are similar reasons for the advertising content. In any case, is the number of editorial pages a valid measure of the value for money? If you try counting words, you will find that in terms of information, E-A offers rather outstanding value for money. By making some further adjustments, we have been able to reinstate Arthur Cushen's column —now titled "Shortwave Scene."

Solar water heater

The looming energy crisis throughout the world and the increasing interest in alternative sources of power brought to mind a series of articles, published in your magazine some years ago, on the construction and installation of a domestic solar hot water heater.

From memory the articles gave full constructional details and would be quite suitable for republishing with little, if any editorial reworking needed. Furthermore, I consider a great many readers would be most interested in such a project, as many readers are handymen as well as electronics ehthusiasts.

Would you give some thought to republishing these articles?

L. Dancey (Townsville, Qld).

COMMENT: It sounds a good idea, and we will certainly give it serious thought. The only catch may be that the original design approach could now be obsolete. We would appreciate comment from other readers.

Annual index

Like most readers, I tried filing articles from the magazine, but gave up about 1958. At that time I started filing the annual index in a folder, which was far more convenient. This system worked reasonably well until the index started to run to more than one page, with one page carrying part of a wanted article. Lacking photocopying facilities, I have had to leave these indices in their respective March issues, which of course makes it more difficult to track down wanted articles in these volumes.

I feel it shouldn't be too difficult to put the index on the two centre pages of the magazine, so that it could be readily extracted for filing. Would this be possible?

J. Walton (Moorabbin, Victoria).

COMMENT: There is only one complication — advertisers quite often make a specific booking of the centre spread. This has in fact happened with the present issue, or we would have followed your suggestion. We will certainly bear the idea in mind for future indices.

Classical Recordings

Reviewed by Julian Russell

Michelangeli — unpredictable maestro

DEBUSSY — Images Books 1 and 2. Children's Corner Suite. Arturo Benedetti Michelangeli (piano). DGG Stereo 2530 196.

CHOPIN — 10 Mazurkas; Prelude in C Sharp Minor, Op. 45; Ballade in G Minor, Op. 23; Scherzo in B Flat Minor. Arturo Benedetti Michelangeli. DGG Stereo 2530 236.

BEETHOVEN — Piano Sonata No. 4 in E Flat Major, Op. 7. Arturo Benedetti Michelangeli. DGG Stereo 2539 197.

By now most readers will have heard about Michelangeli's the unpredictability. His reputation for not turning up at recitals is matched only by his same reluctance to keep appointments in recording studios. His usual excuse goes no further than a brief "indisposed."

Three records by this most brilliant but erratic pianist is therefore not only a bit of luck for the discerning, but the contents advertise the great scope of his powers. Debussy and Chopin. Nothing unusual in that. But Beethoven, too, and such delectable Beethoven in two of the movements, is something not nearly so ordinary.

To start with the Debussy disc, the first of the first series, "Reflets dans l'Eau," shows you the Michelangeli whose dynamics are weighed so scrupulously that it is impossible to capture their subtlety in words. The changes of sonorities are so imponderable that I can compare them only with those of the late Walter Gieseking. To this must be added the amount of perceptive and perfectly produced detail that goes into every bar. Michelangeli can even remove any hint of pedantry from the next item, "Hommage a Rameau." Yet despite the little piece's aristocracy and delicacy it remains wholly masculine in line and temperament. No. 3 is called simply Mouvement, and is a miracle of smooth, fast musical progress, almost machine-like except for sudden unexpected accents leading later into a more complex structure.

The second series begins with Cloches a travers les feuilles, in which Debussy evokes a wonderful atmosphere of rustic peace — a still evening with now and again a scented breeze bringing the sound of bells closer only for them to recede again. In some extraordinary way there is no effort to imitate the sound of the bells themselves, but rather the effect on one who hears them. No. 2, which has the Beaudelaire-like title "Et la Lune descend sur le temple qui fut," offers a magical moonscape of ancient ruins, The last, "Poissons d'or" is self-explanatory — a bowl of goldfish idling and darting.

The Children's Corner Suite has probably some of Debussy's best known music for piano. It starts with the quite unmatched smoothness of Michelangeli's playing of "Dr Gradus ad Parnassum" with its exercise like theme. "Jimbo's lullaby" receives just the right elephantine treatment. In "Serenade for the doll" Michelangeli even manages to hint at the stiff limbs of the toy. "The Snow is Dancing" is another brilliantly evocative piece of landscaping. Then comes "The Little Shepherd" with its hint of piping. And to finish, there is "Golliwog's Cakewalk," probably the first introduction of rabtime into serious music, played with a bouncy rhythm that makes most other accounts even the best, sound almost clumsy. Altogether a Debussy-lover's delight.

If the outstanding feature of Michelangeli's playing of Debussy is its elegant refinement you will find refinement in plenty, but of a different kind in his Chopin. And just as he exposes the soul of Debussy so does he that of Chopin. The first side is devoted to 10 of Chopin's 52 Mazurkas, pieces that are generally considered to be the most Polish of all his works. Again I think I can do no better to describe these pieces by quoting Munich critis's K. H. Ruppel's most perceptive sleeve notes: "In the little jewels — small only as regards their dimensions — of the Mazurkas, Arturo Benedetti Michelangeli shows how Chopin is to be understood — as an incomparable master of contrasting characteristics within an unchanging form, a romantic lyrist who inherited elegance from his French and a fiery temperament from his Polish ancestors." The deceptively simple-sounding mazurkas are not just dances but expressions of the deepest nostalgic patriotism of an expatriate. Their execution is faultless, as is the recorded piano tone on all three of these distinguished discs. I have never heard a more thrilling performance of the Ballade, even from the great Authur Rubinstein himself. It offers an enchanting series of instantly changing moods when meditation takes fire then subsides into tender memories. And who else today can give you such varying changes of sonorities in the Scherzo? Some might think that an occasional rubato is a trifle overdone but the sheer magic of the whole conception — and execution — overwhelms criticism.

The legendary Arturo Benedetti Michelangeli . . .

I have to admit to slight disappointment with the first movement of the Beethoven sonata. Michelangeli's almost metronomic treatment makes it sound rather too objective for so subjective a composer as Beethoven. The playing is immaculately correct, dynamically inflected to perfection, yet the general impression is passionless. Yet even here Michelangeli introduces another wizardly touch — a couple of exquisite rubatos so unexpected and expressive. But otherwise it is all so prim.

I hate to write this way about a player I admire so much but here he is not at his greatest. And one might say the same about the second movement. In this the shaping is perfect and the proportions exemplary but to me it lacks the breath of life. That the playing is faultless goes without saying. But when we come to the last two movements — an allegro and a rondo — the playing has as fresh a bloom on it as I have ever heard. I can't remember ever having received so much pleasure from the third movement even from Arrau himself. You feel that Michelangeli is at last truly involved, completely committed. And the rondo alternates marvellously between contemplation and fiery assertion. In enjoying these two movements you are tempted to forget what has gone before.

★ ★ ★

MOZART — Don Giovanni. Complete Opera. Dietrich Fischer-Dieskau (Don Giovanni); Birgit Nilsson (Donna Anna); Peter Schreier (Don Ottavio); Martina Arroyo (Donna Elvira); Ezio Flagello (Leporello); Martti Talvela (Commendatore); Alfredo Mariotti (Masetto); and Reri Grist (Zerlina) with the Chorus and Orchestra of the National Theatre, Prague, conducted by Karl Bohm. DGG Stereo SKL948-51. Four discs.

Which are the greatest operas ever written? However individual opinion might vary, Figaro and Don Giovanni must be on most music lovers' short list. And both are equally difficult to cast satisfactorily. However impressive a cast might look on paper there is bound to be at least one disappointment. And one disappointment is enough to scar any production, however good the rest of it. Each character is vitally important and the orchestra must not only accompany but have a life of its own. Taken for granted that the conductor is well versed in Mozartian style he must encourage as well as relentlessly discipline all his forces.

But, generalities aside, this DGG issue was made back in 1967; I review it now because I am told that a local production of the Don is likely in the near future.

It is not Fischer-Dieskau's first recording of the opera. His performance under Fricsay in 1959 offers a sneering rather that an aristocratic Don, a sinister sly fellow. But whatever might have been wanting in the characterisation in that set, musically Fischer-Dieskau was in great form. In fact, I wonder at some of his vocal shortcomings in the version under review. In it his voice seems to have hardened and developed a vibrato so wide that it at times develops a

disturbing pulse. Strangely, in his later recordings, he seems to have overcome these faults and has, for many years, been his old eloquent self. Did he have a cold or some other affliction when the Fricsay was made. I am tempted to think so.

Characterwise in the new DGG issue he has abandoned some of the less likeable characteristics of the role and substituted a bluffer, much tougher fibred man. Again his present performance gains distinction over the previous one whenever he meets the beautifully wrought Leporello of Flagello. Each seems to inspire the other and I found their encounters one of the opera's most atttactive features. But, here, less than the expected amount of co-operation comes from the orchestra whose playing is, to put it mildly, pedestrian. Even under the customarily firm direction of Bohm they seldom quite rise to any occasion. I suspect that Bohm himself was far from happy with what was going on. Note the uncommonly fast tempo he uses in the final scene, in an apparent effort to get the whole thing moving satisfactorily. But, even here, the result is far from happy.

In most DGG recordings one is used to the voice being brought forward at the expense of the orchestral background but, here, the liveliest moments in the drama become static when the singers take over the whole score. This is definitely not DGG's best.

Among the more attractive features, I would mention Reri Grist's Zerlina, who not only offers a voice of unremitting charm but uses it to characterise the part vividly. The Donna Elvira is Martina Arroyo, who is also possessed of a voice as rich as it is well used, but she gives little sense of the nature of her part.

We now come to something of a puzzle — the casting of Birgit Nilsson as Donna Anna. True this character needs a big voice and a wide range of emphatic gestures. But this is Mozart, not Wagner or Strauss, and Mozart has too many bars that expose minor failings that would pass in the work of the other two composers. Moreover when it comes to Mozartian decoration Nilsson sounds almost brutally clumsy. If ever there was a case of serious miscasting this is it.

Among the men in the more of less minor roles Mariotto's Masetto is the most attractive to me, a rich-toned but never booming bass. Talvela's Commendatore is not at his best in his first scene but atones handsomely at the end. Don Ottavio (Peter Schreier) is uneven chiefly because of the disappointing tone of his high register.

Altogether, this is not a set that I can recommend nowadays, with any great enthusiasm. As a more accomplished alternative I suggest you hear either the Klemperer or Giulini versions before making any decision. True, the differences between the three sets might be subject to debate but the tutored ear will, I think, find them of importance.

★ ★ ★

DUBOIS — Concerto for alto saxophone and string orchestra.
VILLA-LOBOS — Fantasia for soprano saxophone, three horns and strings.
IBERT — Chamber concertino for alto saxophone and 11 instruments.
Glazounov — Concerto for alto saxophone and strings. Eugene Rousseau (Saxophone) with the Paul Kuentze Chamber Orchestra conducted by Kuentze. DGG Stereo 2530 209.

Concertgoers seldom hear serious music written for saxophone as a solo instrument. Many "classical" composers have used it as an orchestral component where its presence often passes unnoticed. But Bizet, Saint-Saens, Delibes, d'Indy, and outside France, Mahler and Hindemith, have incorporated the instrument into their scores. Saxophones are particularly conspicuous in Strauss' Domestic Symphony but how many musical people have noticed that there is a saxophone part in a work as well known as Ravel's Bolero? Despite all this it has never won complete respectability. About it still hangs something of the raffish atmosphere of the jazz band.

On this disc I was not surprised to find Dubois, Ibert and Villa-Lobos writing for saxophone but I thought the presence of Glazounov, a model of epigonous respectability, writing for it — and writing well — very surprising indeed. Indeed his contribution is my favourite among the four recorded here. One of the concertos is by Dubois, a 43-year-old pupil of Milhaud, who taught him well — perhaps a little too well. For though the concerto is beautifully put together, its spirit is still that of the French school of the middle 1920s — a few years before Dubois was born. I liked best the slow movement, a sarabande — another echo of Milhaud in one of his Latin American moods.

More authentically Latin-American is Villa-Lobos Fantasia for soprano saxophone and string orchestra with three horns. Although written in 1948 it is much more persuasive — and mellifluous than Dubois'. It has a strongly dance-like first movement that moves fluently and brightly, giving good opportunities to both soloist and orchestra to shine. The Finale, which follows straight on after a brief slow interlude is again strongly rhythmic and entertaining — if little more.

Those who know Ibert by his now famous and witty Divertissement for orchestra will not be surprised by his Chamber Concertino for Saxophone and 11 instruments. It is a tuneful, skilful, not altogether serious contribution, beautifully polished. Yet it is fundamentally shallow and the almost motoric progress of the first movement soon starts to tire the listener. I must mention here that there persists throughout the whole production a long reverberatory period so prounced that at times it and Strings opens with the latter inchestra, when it enters, goes on to pay its full respects to Ravel. The Finale is a fast movement of industriously applied mediocrity.

The Glazounov Concerto for Saxophone anf Strings opens with the latter instruments playing with impressive tone while maintaining perfect balance with the ordinarily self-assertive saxophone. The concerto is a one movement work that goes through many rhapsodic changes of moods and tempos. It is full of telling contrasts and mellifluous tunes, all expertly treated. It makes the other three works sound very "smart Alec," even the better-than-average Villa-Lobos. Rousseau plays the solo part with enough skill and polish to successfully demand respectful attention. The orchestral parts throughout the disc are always admirably handled by Paul Kuentze, but tonally, while the engineer has captured the saxophone's timbre with complete fidelity — oh, that reverberation!

(Continued on P. 95)

Variety Fare

Reviews of other recordings

Devotional Records

TIME TO RUN. Original Motion Picture Soundtrack, by Tedd Smith. World Wide WWR-1001. (From S. John Bacon Publishing Co, Pty Ltd, 119 Burwood Rd, Vic 3125. $5.95.)

One is always at a disadvantage listening to a soundtrack album without having seen the film. Perhaps I should say "the films," because two of the tracks are credited to the production "Isn't It Good To Know." Whatever the connection, the titles seem to add up to a story line beginning with a challenge and ending up with dedication: Catch Me — I Love You — Time To Run — Travelling Man — Gone Away — Because We Understand Each Other — Alleluia — Isn't It Good To Know Where You're Going — Meditation — What Shall I Give Unto The Lord?

Like so many of the recent Gospel musicals and films, this one seems primarily to be youth orientated and it is to youth it will have its major appeal. If you know the film or you know the songs, you can buy the album with confidence. The quality is good and it responds well to presentation in simulated quadraphonic. (W.N.W.)

★ ★ ★

BEAUTIFUL NORFOLK ISLAND. Eric Jupp Orchestra and Chorale, with Shirley McDonald and Neil Williams. Stereo, 7in 45rpm, Bounty Records, Box 375, Norfolk Island 2899.

When in Norfolk Island recently, I had a chat with Shirley McDonald, who told me of this new semi-devotional EP, then in the course of production.

Packaged in a 12-page, full-colour booklet-folder, it will be an attractive reminder for all those who have enjoyed the atmosphere of the tiny Pacific Island. At least, that's the way it appealed to me.

There are four tracks on the disc: "Beautiful Norfolk Island," tuneful and atmospheric, which reminded me of "Beautiful Isle Of Somewhere;" "The Ballad Of Barney Duffy," a piece of local folklore, set pleasantly to music; "The Ship Of Fame," a Norfolk / Pitcairn evangelical song; "The Pitcairn Anthem," also devotional.

Even if you've never been to Norfolk, you'll find it very enjoyable. (W.N.W.)

★ ★ ★

HYMNS FOR ALL SEASONS. Choir of King's College, Cambridge. With the Philip Jones Brass Ensemble; Ian Hare, organ; Directed by David Willocks. Stereo, HMV CSD 3739.

As an avid photographer, with colour slides of the Kings College and environs, I would have been tempted anyway by the jacket photo of the lofty interior. And the music is completely in keeping. The nineteen tracks play for a full hour and contain hymns which are widely used throughout many denominations during the Christmas and Easter seasons.

Abbreviated, the titles are: Come Thou Redeemer — Hark, The Herald Angels — As With Gladness — Drop, Drop Slow Tears — When I Survey — Ye Choirs of New Jerusalem — The Head That Once — Come Down, O Love Divine — Holy, Holy, Holy — Praise To The Holiest — Sleepers Awake — O Come All Ye Faithful — Bethlehem Of Noblest Cities — Dear Lord And Father — O Sacred Head — Jesus Christ Is Risen — Hail The Day — Come, Holy Ghost — O Praise Ye The Lord.

The combination of a boys choir, mature male voices, organ and brass, plus the ambience of the building makes for some rich sound. And the choir and musicians are as good as you'd expect them to be. If you like this kind of music — and many do — the recording is good value. (W.N.W.)

Instrumental, Vocal and Humour

AN EVENING OF CLASSICAL FAVOURITES VOL. 7. Various artists and orchestras. Stereo, Fontana 6545 040.

A pleasant enough collection of popular light classics. Although not all the artists represented could be called first rate, and while some of the recordings are fairly old, at the low Fontana price this disc should attract sufficient buyers to justify its release. The titles are: Jesu, Joy of Man's Desiring (Bach) — Ave Verum Corpus (Mozart) — Violin Romance No. 2 (Beethoven) — Melody in F (Rubenstein) — Clog Dance (Lortzing) — Ave Maria (Schubert) — Hungarian Rhapsody No. 5 (Liszt) — Panis Angelicus (Franck). (H.A.T.)

★ ★ ★

THE MUSIC LOVERS. Music by Tchaikovsky, Andre Previn and the London Symphony Orchestra, Stereo, United Artists (Festival) SUAL-934110.

From the film soundtrack, this album may well have a special appeal for those who saw the film and can associate the story theme with particular excerpts. For others it will be snippets of the tuneful music of Tchaikovsky, played by a substantive orchestra but identifiable for what it is — a soundtrack.

The titles relate to aspects of the story but the excerpts are identified in small type: Scherzo Burlesque and Dance of the Clowns — Piano Concerto in B Flat Minor — Eugene Onegin — 6th Symphony and Manfred Symphony — Romeo and Juliet Overture — Miniature March — 1812 Overture — 6th Symphony, adagio.

Enthusiasts with a penchant for the classics may have little use for snippets of this kind, particularly mixtures of snippets, but others will welcome it as a change from purely popular fare. The quality is clean and well balanced but not otherwise notable. (W.N.W.)

★ ★ ★

CAST YOUR FATE TO THE WIND. The exotic sounds of Arthur Lyman. Sunset stereo L 15252.

I must say I do enjoy the sounds of Arthur Lyman with his exotic sounding collection of vibes, marimbas, congas, guitars, glockenspiel, gourds and wooden blocks. Even fake bird calls. But the tracks on this album are a mixed bag — some are good, some are a drag. Arthur should forget his conch shell (in the first track listed) and "Slaughter On Tenth Avenue" is not his cup of tea.

Recording quality is good and stereo spread is wide. Some tape hiss but not over-obtrusive.

There are twelve tracks: Pu Pu Hino Hino — Cricket Of Karachi — Cindy Oh Cindy — Cast Your Fate To The Wind — Song Of Delilah — Slaughter On Tenth Avenue — Similau — Days Of Wine And Roses — Te Manu Pukarua — Waltz Latino — China Nights — Night Train. (L.D.S.)

★ ★ ★

MUSIC FROM THE MOVIES. Philip Green and his orchestra. Stereo, Calendar (Festival) L-15129.

It would be difficult to guess how many times numbers like those on this album have been recorded under a similar title, but it's probably a measure of how popular they are: Sunrise, Sunset —Hello, Dolly — Chim Chim Cherie — Edelweiss — People — Mame — "Godfather" Theme — A Man And A Woman — "A Summer Place" Theme — Love Is A Many Splendoured Thing — Days Of Wine And Roses.

The Philip Green orchestra is easy on the ear but essentially no different from a half dozen others which rely heavily on singing strings, with well rounded woodwinds and gentle percussion for relief. The quality is average, with some "edge" noticeable on the strings on a wide-range system. (W.N.W.)

★ ★ ★

BLACK MAGIC. Artie Shaw Orchestra. Stereo, Astor Gold Star series, COPS-6844.

If you like the somewhat big-band sound of Artie Shaw, then this one could be for you — either as feature sound or played low as a background for other activities. The titles: That Old Black Magic —All The Things You Are — It Could Happen To You — These Foolish Things — I Remember You — They Can't Take That Away From Me — My Funny Valentine — September Song — I'll Be Seeing You — Long Ago.

If the numbers appeal, the quality is good. (W.N.W.)

★ ★ ★

Reviews in this section are by Neville Williams (W.N.W), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.), Gil Wahlquist (G.W.), and Norman Marks (N.J.M.).

MYRON FLOREN'S OLD TIME WALTZES. Lawrence Welk. Stereo, Interfusion (Festival) L-25036.

Apart from the inclusion of a couple of "modern" numbers, Lawrence Welk has done nothing to compromise the old-world atmosphere of the title and the jacket. Myron Floren on accordian provides the melody, while a small backing group provides modest percussion. The titles: Over The Waves — Edelweiss — You Can't Be True Dear — Expectation Waltz — My Heart Cries For You — Somewhere My Love — Oberek No. 1 — Blue Skirt Waltz — Skater's Waltz — Put You Little Foot — Petite Waltz — Waves Of The Danube.

Given a bit of nostalgia, you'll reckon the $3.99 well enough spent but, otherwise, don't expect anything exciting. (W.N.W.)

★ ★ ★

THE BRITISH GRENADIERS ON PARADE. The Grenadier Guard Band conducted by Major Peter Parkes. London stereo LBS 702.

"Oh, goody" I thought, "another rousing brass band record." But I was disappointed, for in my opinion the performance lacks life. Some of the quieter tracks are okay but the rousing ones aren't. Recording quality is good and the stereo spread is fine.

Eleven tracks are featured: John F. Kennedy March — The British Grenadiers On Parade — Trumpet Tune And Air — A Festival Overture — Knightsbridge March South Rampart Street Parade — From Maine To Oregon — A Scottish Patrol — Waltzing Clarinets — Finale: Hands Across The Sea. (L.D.S.)

★ ★ ★

EDINBURGH MILITARY TATTOO, 1973. Various Pipe and Military Bands. Stereo, EMI SZLP-2138.

Of special interest to some will be the fact that a pipe band from Scots College, Sydney, was present at the 1973 Edinburgh Military Tattoo, being one of several such bands which are heard on Side 1 of this album. The pipe bands are followed by several military bands from traditional Scottish regiments.

It is primarily a record of an occasion and its appeal will be to those who may have had past links with the Edinburgh scene, and who will respond to the sound of the pipe and military bands. If you do buy a copy, royalties from the sale will go to the Forces Benevolent Fund. Quality, by the way, is quite okay. (W.N.W.)

MORE OF ZORBA AND OTHER GREEK DANCES. Costa Costas and his orchestra. Harlequin stereo L 25049.

"Greek dances sung and played in authentic manner" adequately sums up this album. Recording quality is good and surface noise low. Price is $3.99.

Tracks are as follows: Theme from "Zorba the Greek" — Athina — Kalamatianos — Ya Sena Mana — Fiyeh Fiyeh — Vlahikos Horos — Tou Psara To Krima — Lemonia — Velisario — Melina — Poli Kala — Ababaca. (L.D.S.).

★ ★ ★

GLADYS MONCRIEFF ENCORES. Mono, Columbia OEX 10041.

I doubt whether the interest in this collection of ancient tracks by Australia's singing star of the 20s and 30s will extend beyond those who have already bought similar discs already issued. Indeed, if one adopts the charitable view, the record companies must be scraping the bottom of the barrel for this artiste's recorded material, as some of the tracks here are definitely substandard, vocally as well as musically and technically. However, if you want Moncrieff souvenirs, here is what is

(Continued next page)

Budget cassette release from ARC

Highlighting the market swing towards prerecorded cassettes, the Australian Record Company has just announced their first large scale release of cassettes at the budget price of $3.98.

The first batch of CBS "Harmony Stereo" cassettes contains 18 titles, all of them by well known artists and orchestras, and all of them in the middle-of-the-road popular field. (A further large batch has since been announced.)

One would judge from the titles that they are cassette replicas of the Company's most successful LP disc albums. As such, they should have a strong attraction for enthusiasts keen to build up a library for use in home, car and portable player.

With one exception, as noted later, the recordings are technically good, smooth and wide range, and free from obvious wow and flutter.

Our comments follow on a few of the cassettes, those which happened to be immediately on hand.

Other artists represented in the first release include: Bobby Vinton, Ken Griffin, Andre Kostelanetz, Charlie Byrd, Andy Williams, Tammy Wynette, Johnny Cash, Jim Nabors, Peter Nero, Johnnie Ray, Louis Armstrong and Doris Day.

★ ★ ★

BRIDGE OVER TROUBLED WATER. Robert Goulet. HC1015.

Smooth, and masculine, the voice of Robert Goulet makes good listening as ever with: For Once In My Life — Something's Gotta Give — All I Do Is Dream Of You — Stella By Starlight — Ebb Tide — Laura — This Guy's In Love With You — I'll Take Romance — Don't Blame Me — Bridge Over Troubled Water. A good one.

★ ★ ★

JOHNNY MATHIS. HC1030.

Mainly romantic are the themes on this cassette by male vocalist Johnny Mathis. The better known ones are: A Lovely Way To Spend An Evening — I'm In The Mood For Love — Don't Blame Me — On The Sunny Side Of The Street. If you don't know Johnny Mathis' style, better listen a bit. It doesn't appeal to everyone.

★ ★ ★

MITCH MILLER AND THE GANG, NIGHT TIME SINGALONG, HC1005.

Mitch Miller's "Gang" includes chorus and orchestra, performing in their established and well known style. The emphasis is on the tuneful "oldies," including: Don't Bring Lulu — You Oughta Be In Pictures — Night And Day — The Lady In Red — Sweet Georgia Brown. There are about 17 titles in all. If you like Mitch, you'll like this one.

★ ★ ★

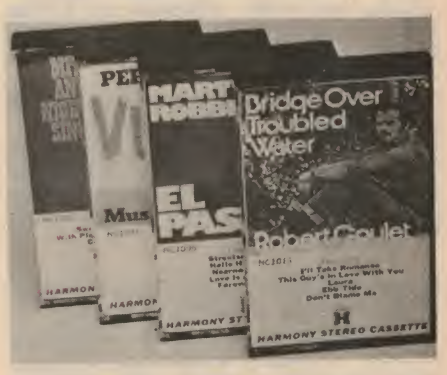
EL PASO. Marty Robbins. HC1006.

Whether or not you know Marty Robbins, you will certainly recognise the particular numbers on this cassette, not just the titles but the particular versions. C&W doesn't come any smoother or more listenable than here: El Paso — The Wine Flowed Freely — Streets Of Laredo — The Hanging Tree — Bouquet Of Roses — Hello Heartaches — Forever Yours — The Nearness Of You — My Wonderful One — Love Is In The Air. Sounds fine in simulated 4-channel.

★ ★ ★

A LITTLE BIT OF LOVE. Julie Andrews. HC1019.

This is the Julie Andrews of "Sound Of Music," full of simple charm, faultless diction and melody, and therefore likely to lure a lot of listeners to part with their $3.98. The titles are popular but add up only to 9 in



number: A Little Bit Of Love — I Feel Pretty — How Can I Wait — Burlington Bertie — If Love Were All — Waiting At The Church — Looking For A Boy — By The Light Of The Silvery Moon.

★ ★ ★

VIVA, MUSIC OF MEXICO. Percy Faith Orchestra. HC1001.

There's a Mexican touch about this offering from Percy Faith but there's a strong body of singing strings to keep you from straying too far south of the border. In fact, it's a very pleasant blend, appropriate either for higher level listening or as a gentle background. Included in the 16-odd titles are: Granada — El Ranch Grande — La Paloma — La Cucuracha — Estrellita — Mexican Hat Dance. The title is apt: "Viva".

★ ★ ★

THE SECOND BARBRA STREISAND ALBUM. HC1016.

Barbra Streisand is not someone to whom I would choose to listen, but her popularity with another member of the family brands my reaction as a purely personal one. If you like Barbra, this cassette will bring you: Any Place I Hang My Hat Is Home — Right As The Rain — Down With Love — Who Will Buy? — When The Sun Comes Out — Gotta Move — My Colouring Book — I Don't Care Much — Lover, Come Back To Me — I Stayed Too Long At The Fair — Like A Straw In The Wind. (W.N.W.)

VARIETY FARE

offering in this selection: L'Amour Tojours L'Amour — Love Is A Dreamer — Speak To Me Of Love —I Was Dreaming — The Purity Brigade—Where The Shannon Flows — Smiling Irish Eyes — Come Back To Me — Love's Young Dream — I Wait For You — Heavenly Night — A Wee Bit Of Love. (H.A.T.).

★ ★ ★

PIANO SOLOS. Dick Hughes. Festival stereo L25066.

Dick Hughes has been a personality on the Sydney jazz scene for a long time — he has written jazz columns regularly for the Daily Mirror and the Sunday Mirror. He has played in many Sydney jazz groups and had his own, the Dick Hughes Quartet In October 1973, he became the first jazz pianist to play in the Opera House.

Actually, these tracks were put down to be but part of an album in a series (The Fred Starkey Foundation Series) recently released by Festival. But apparently the session went so smoothly (some tunes actually composed on the spot) that a whole album was produced. Mostly blues, it makes very easy listening on a dull Saturday afternoon when all the sports fixtures have been cancelled. Recording quality is good throughout.

Tracks on the album are: Mamie's Blues — Mama Doors — Don't Blame Me — Untitled Blues No 1 — Blues With No Reason — Blues In E No 1 — Within Boy Blues — Dinks Blues — Untitled No 2 — Mr Jelly Lord — Blues Serenade — Blues in E Flat No 2. (L.D.S.)

★ ★ ★

SARAH VAUGHN, NIGHT SONG. Philips International series Stereo 6499 575.

I doubt if many singers can match the vocal skill of "Sassy" and this record amply demonstrates why, with a dozen all-time hits such as: Night Song — The Boy From Ipanema — Fascinating Rhythm — Mr Lucky — Fever — Shiny Stockings — Stompin' At The Savoy — Avalon — Tea For Tea — Quiet Nights — The Moment Of Truth — Jive Samba.

The pressing was originally released in 1964 on the Mercury Label and the quality has not suffered from age. The mood is a mixture of Latin and Jazz and is very easy to listen to. There is a complete listing of the musicians involved in each recording session for those interested. At $3.98 it's a steal. (N.J.M.).

★ ★ ★

MARY IN THE MORNING. Al Martino, with orchestra and chorus. Stereo, Capitol (EMI) series 299 SENC-10047.

Maybe Al Martino is an old-fashioned baritone, with an old fashioned regard for lyrics and melody, but he's very easy on the ear. And he's complemented here by a gently swinging orchestra and chorus.

The theme is love: Mary In The Morning — Love Me Tender — Love Letters In The Sand — My Love Is Stronger Than My Pride — Unchained Melody — Red Is Red — Can't Take My Eyes Off You — Release Me — I Dream Of You — Now — Making Memories. Memories.

As the jacket note says: "Listen gently, listen attentively." A good buy at the budget price. (W.N.W.)

★ ★ ★

MUSIC MAKES MY DAY. Barry Crocker. Festival L35016.

Barry Crocker demonstrates his skill as a ballad singer with a pleasing rendering of: My Song Is Your Song — All In All — My Love — Falling in Love Again — Music Makes My Day — Wheeling West Virginia — Susie Darlin' — You Can Never Go Home — Neither One Of Us — Marmaduke — Lonely Bus — Is This the Way.

Some of the numbers have been multi-tracked so you get 2 or 3 Barry Crockers for the price of one! Five tracks were recorded in London and the rest in Melbourne. (N.J.M.)

★ ★ ★

GREG ANDERSON. Festival Harlequin series L25053.

If there was a prize for clarity of diction, I'm sure this singer would walk away with it. Looking like a young Richard Chamberlain he gives a pleasant rendition of thirteen hits including: Beautiful People — The Drifter — Its Wrong — Thank Your Lucky Stars — Ned Kelly —Live For Life — A Young Girl Came Into My Life — It's The Wrong Time. Recorded locally, the quality leaves no room for complaint (N.J.M.).

★ ★ ★

NON-STOP MANCINI, The Sunset Festival Orchestra. Harlequin Series L25035 Festival release.

If you would like a collection of many of Henry Mancini's hits and film themes, this $3.98 bargain would be hard to pass by. There are sixteen tracks including such favourites as: How soon — Charade — The Pink Panther — Baby Elephant Walk — Sunflower Theme — Days Of Wine And Roses — Peter Gunn — Mr Lucky — Dear Heart — Cades Country — Moon River.

The quality is superb except for a slight tizziness on the inner track on one side. If your ears and speakers can stand it try the Peter Gunn track at a high level for an acoustic thrill. (N.J.M.)

★ ★ ★

BLACK BYRD. Donald Byrd. United Artist stereo L34957.

I know that Donald Byrd is acclaimed as one of the great jazz trumpeters in the business and he has total involvement in Afro-American music (the album notes tell you all that) but I found it dead monotonous. Penny whistles, trumpets, rhythm accompaniment and heavy driving bass sum up the seven tracks. They all sound the same. That bleat is getting all too common these days. Record quality is okay.

Tracks are as follows: Flight Time — Black Byrd — Love's So Far Away — Mr Thomas — Sky High — Slop Jar Blues — Where Are We Going? (L.D.S.)

★ ★ ★

DAS GOLDENE AKKORDEON. Will Glahe. Decca stereo SCLA 7056.

Here is a fine record of traditional accordion playing of popular melodies. Will Glahe is featured with three groups and they all put out some very pleasant sounds. Quality is good and the price is just $2.99.

There are twelve tracks and some are in medley form: Bonjour, Bonjour — Bingo Bengo — Quicksilver Polka — Manana — El Condor Pasa — Heidemarie — Casatschok — Babushkin — Rosamunde. (L.D.S.)

★ ★ ★

OLD TIME FAVOURITES. Hal Carter and Jack Speering. Stereo, Festival Harlequin series L-25047.

Like to dance? Like evergreen songs in strict tempo? Want to revive memories of the old-time dance hall? Well, Hal Carter and Jack Speering will certainly provide the wherewithal: South Of The Border — Moonlight And Roses — I Want A Girl — A Rose In Old Killarney — You're Irish and Beautiful — Sweet Rosie O'Grady — The Sunshine of Your Smile — Cinderella — Alice Blue Gown — Gypsy Moon — Ma — I'm Just Wild About Harry — Mexicali Rose.

That adds up to a considerable 14 tracks for $3.99 — good value, provided you're in the market for the particular type of recording. (W.N.W.)

MAYNARD PARKER, MIDNIGHT RIDER. Prestige Stereo L-34926. Festival release.

With a small backing group of electric piano, bass organ and drums, Maynard Parker produces eight numbers with a soft rock sound that are very easy to listen or dance to. Some of the titles, such as "The World Is A Ghetto" and "Freedom Jazz Dance," carry a hint of protest.

The other tracks are: Killing Me Softly With His Song — Midnight Rider — Mama Told Me Not To Come — Lady Sings The Blues — One Hand — Bad Montana. The recording quality is excellent; if you like the titles give the disc a hearing. (N.J.M.)

★ ★ ★

I REMEMBER HANK WILLIAMS. Glen Campbell. Capitol stereo SW 11523.

To me, Hank Williams' songs sung by Glen Campbell spell unrelieved misery.

STEAM TRAINS

MORE STEAM IN SOUTH AUSTRALIA. 7-inch 33rpm. AA7 NARROW GAUGE, VOLUME TWO. 7-inch 33rpm. AA6.

In major centres in Australia, small groups of enthusiasts put in an incredible amount of work, not only to maintain steam train museums, but fully serviceable locos. Let them appear anytime for an excursion and you can be sure that their path will be marked by photographers and recordists.

These two records, produced by Bill Mudie, relate respectively to South Australian broad gauge and narrow gauge trains and, for good measure, capture the sound of one of the few remaining Murray River steamers.

Record AA6 features the powerful 3ft 6in Beyer Garrats, which were rendered redundant in 1969 by the opening of the standard gauge line. AA7 records the four broad gauge locos still running in SA.

The sound is well recorded. Some of it is in mono, some of it is mono "fiddled" from one side to the other by faders, and some of it is in genuine stereo. But it's all train noise, with very little tape hiss or other extraneous noise.

The records retail at $2.00 each and, according to a note from Mrs Mudie, are available through most railway enthusiast groups. They are also available direct for $2.12 posted from: R. A. Mudie, 23 Douglas St, Lockleys 5032.

Definitely, Glen needs a lighter touch when singing songs of this sort. And if that's not bad enough, the recording quality is lousy — not just merely dull but badly distorted in parts. I suppose it is possible I could have had a bad pressing but unless you're really keen on Glen Campbell, give it a big miss. (L.D.S.)

★ ★ ★

VIKKI. Vikki Carr. Sunset stereo L-15249.

One can admire a performer like Vikki Carr. She always puts in a consistent performance and does not require a whole load of promotion to survive in the cut-throat showbiz world. I certainly have no argument with her performance but the recording standard is definitely on the poor side. I had to check my cartridge several times to see whether the stylus was dirty.

Twelve tracks are featured: No Sun Today — By The Time I Get To Phoenix — Never My Love — Lazy Day — There I Go — The Lesson — Everything I Touch Turns To Tears — Watch What Happens — For Once In My Life — The Real Me — This Is The House That Jack Built — Go. (L.D.S.).

★ ★ ★

TED HAMILTON'S NEW WAVE. With Brian May and the ABC Show Band. ATA Records (Festival).

It takes some adjustment to swap the prosaic image of a TV cop for smooth, polished singer but that's what you have to do when you listen to the new Ted Hamilton. As a singer, composer and lyricist, he has everything going for him. With songs by Michel Le Grand, Rod McKuen, Kris Kristofferson and himself, he covers a variety of styles and moods: I'll Catch The Sun — Without You — You Can Never Go Home — Dandenong Grass — What Are You Doing The Rest Of Your Life — Getting To Know You — Welcome Me Home — Help Me Make It Through The Night — Love Is Need — The Impossible Dream — Citizen John.

If you've watched Ted Hamilton on ABC television, you'll recognise the songs and the band, transcribed from the air waves to a spinning disc. As you'd expect, quality is excellent. (W.N.W.)

Classical — from p91

POPULAR STRING MUSIC — Carl Pini Quartet in pieces by Tchaikovsky, Boccherini, Schubert, Wolf, Beethoven, Borodin, Bartok and others. EMI Mono SOXLP7571.

The Sydney-based Carl Pini String Quartet have recorded a disc of popular string music whose title explains the contents perfectly. Many of the pieces are of the Palm Court variety — the Andante Cantabile of Tchaikovsky, Boccherini's Minuet, the Borodin Nocturne and so on. There are, however, a few refreshing surprises. The sound, recorded in Australia, is right up to the best of modern overseas standards. The quartet members play with praiseworthy unanimity, though emotionally their performance is, for the most part, on the pallid side. In the Schubert Scherzo from his Death and the Maiden quartet, the playing is never less than impressive but a little unsmiling. Wolf's Italian Serenade also cannot be challenged technically. It has faultless accuracy yet is also on the earnest side. The tendency is to make it sound a difficult instead of a deliciously, insouciant trifle effortlessly tossed off.

Beethoven's Alla Danza Tedesca from his Quartet. Op. 130 in B Flat Major is not one of the best examples from this great cycle. Its effect was intended to be in the contrast — in its true context — with what has gone before and what follows. Nakedly exposed, as it is here, it sounds commonplace.

The Borodin Nocturne from the second string quartet is impeccably played in true Wintergarden style, the Mendelssohn Canzonetta from his first quarter in E Flat Major has just the right neatness of touch. Written when the composer was not yet 20 years old it shows his usual precocity with a middle section very reminiscent of his Midsummer Night's Dream overture.

A very real surprise is to find among such a collection the pizzicato movement from Bartok's Fourth String Quartet, with its daring innovations of many different types of plucked strings. A brisk, sensitive and stylish performance of Schubert's Quartet Satz makes an eminently datisfactory ending to the recital and left me hoping to hear the players in more serious music despite the fact that I wasn't very happy with their Debussy Quartet, some months ago. A word of special praise, too, for the recording engineer, Martin Benge, and the producer, L. S. Hodge.

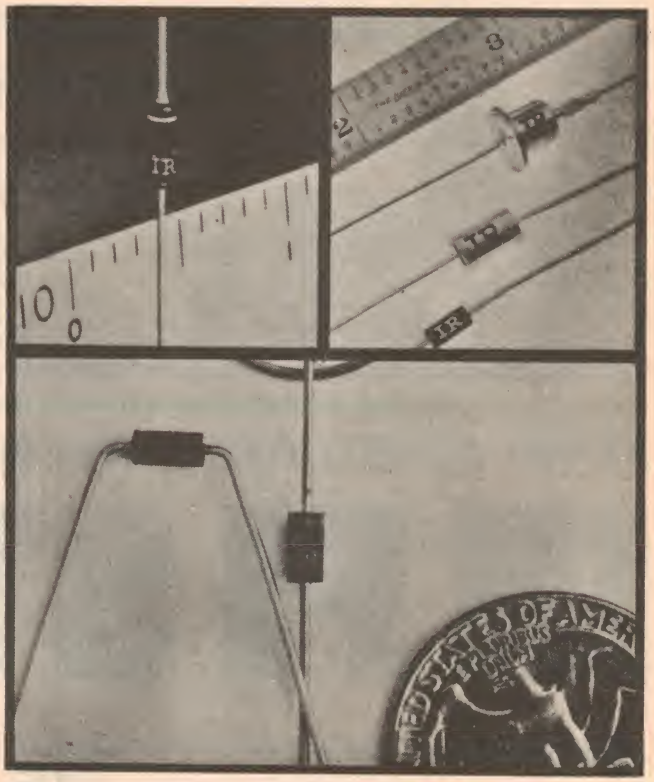
Low power diodes & voltage regulator diodes • High power diodes, klipsels & selenium • Thyristors, triacs & firing circuits • Light sensitive devices • High speed fuse links • Passivated assembled circuit elements • Solid state relays • H.V. rectifiers.

Semiconductor News

IOR

FEBRUARY, 1974

FALLING PRICES



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Product reviews & releases

Revox A78 Stereo Amplifier

The Revox A78 is the successor to the highly respected Revox A50. The A78 has similar appearance and specifications to the A50, but has extra facilities and quite a number of internal changes.

The new amplifier has a more subdued appearance than the A50 and matches the appearance of the latest models of the A77 tape recorder. The front panel is finished largely in grey enamel while the drop down cover carrying the Revox trade name and hiding the level setting controls is now a scratch-grain finished aluminium extrusion, instead of a chrome-plated plastic moulding.

Overall dimensions of the amplifier are 413 x 160 x 250mm (W x H x D including knobs and feet, and the weight is 8.2kg. An oiled teak case is fitted so that the amplifier

can be used standing on a shelf or panel mounted with the aid of suitable brackets.

Rotary switches are provided for the Mode and Selector controls and also for the Bass and Treble controls. The switches are fully enclosed printed circuit types. Five push-button switches provide the following facilities: Tape Monitor, Loudness (Low), Presence, Low Filter and High Filter. Three jack sockets are provided, for an output to a tape recorder and for connection of two pairs of stereo headphones.

The drop-down cover at the top of the control panel conceals preset controls for all the inputs provided on the rear panel. These may be set so the loudness of each source is approximately the same. This is a most important feature — not only does it avoid abrupt changes in loudness level when switching between sources, but it can avoid problems of overload in the amplifier's preamp stages.

Also concealed by the drop-down cover are the mains fuse and the loudspeaker muting switches. Any or both of two pairs of loudspeaker systems may be connected to the amplifier outputs. If one pair of loudspeakers is connected, their nominal impedance may be 4 to 16 ohms; if two pairs are connected, the nominal impedance of each system must not be less than 8 ohms. If this rule is not followed, fuses may be blown and damage to the amplifier may result.

The rear panel of the A78 appears identical to the earlier A50 model. It is a massive aluminium casting which acts as the heatsink for the output transistors as well as accommodating the input and output connections. The output transistor cases are protected from the possibility of shorts to the chassis by plastic covers.

Three-pin sockets are provided for loudspeaker connection via two-pin DIN plugs. When the plugs are inserted one way, loudspeakers with impedance 4 to 16 ohms can be connected as discussed above. When the plug is inserted the other way, the amplifier can be used with electrostatic loudspeaker systems or transformer coupled PA systems.

The only complaint we have with the external finish is that stick-on labels are used to identify the connections on the rear panel. Inevitably, these will tend to peel off after a period of use.

The amplifier contains some 36 silicon transistors and 25 diodes including rectifiers. We did not have access to the circuit diagram at the time of writing but we have determined that the output stages are quasi-complementary using high power silicon transistors. The DC supply to the power stages consists of balanced positive and negative lines, which eliminate the output coupling capacitors. This assures full power output and good loudspeaker damping at low frequencies.

Rated power output of the amplifier totals 80 watts continuous (40W per channel) into 4 or 8-ohm loads or 50 watts continuous (25W per channel) into 16-ohm loads. Distortion is rated at less than 0.1pc at 40W into 8-ohm loads at 1kHz and less than 0.3pc at the same power level for the range from 40Hz to 15kHz.

We measured power output at 45 watts per channel into 8 ohms with both channels driven at 1kHz; total harmonic distortion was less than 0.1pc. Power into 4-ohm loads was 49 watts per channel while into 16-ohm loads it was 30 watts per channel. In other words the A78 comfortably meets the specifications for power output. We also verified that total harmonic distortion was less than 0.3pc up to 40W into 8 ohms for the above specified frequency range for all inputs. Power bandwidth was also verified at better than 10Hz to 40kHz.

Separation between channels, with respect to rated power into 8-ohm loads, ranged from 50dB at 10kHz to 72dB at 100Hz. This is excellent. Signal to noise ratios with the various inputs set for maximum sensitivity was 72dB with respect to rated power for the tape and tuner inputs, 60dB for the high impedance Auxiliary input and 50dB for the magnetic cartridge input.

When the gain of the magnetic cartridge input is reduced to its minimum value of 7.5mV with the preset potentiometer, the signal to noise ratio improves to 60dB. A large component of the noise for this input was hum and we gained the impression that better results could have been obtained if the amplifier was supplied with a mains cord which included an earth wire. As it stands, a separate earth connection must be provided for the amplifier otherwise there is a strong buzz emitted from the speakers when the unit is used with typical turntables.

Even apart from hum, our impression was that the signal to noise ratio was not as good as if could be and was not as good as the previous model we tested back in October 1969.

Overload margin for the magnetic input was adequate and the sensitivity adjustment to suit different cartridges means that overloads should never occur.

Other specifications such as frequency response, tone control characteristics and sensitivity were all on the button, apart from the sensitivity of the tuner input which was 250mV instead of 100mV as claimed — not that this is very important. The balance control is unusual in that it has a range of plus 3dB and minus 10dB for each channel. This gives smooth control and is better than those controls which provide complete channel cut-off at extremes of rotation.

In listening tests, the amplifier performs well and is generally quiet at all normal control settings. It has plenty of power in reserve at normal listening levels and the control layout and facilities make it easy to use. It can be summed up as being rugged and well-built and should be very reliable. Its control facilities are usefully flexible without being gimmicky. Our only disappointment was that residual noise could have been lower but this should not be any problem with most systems.

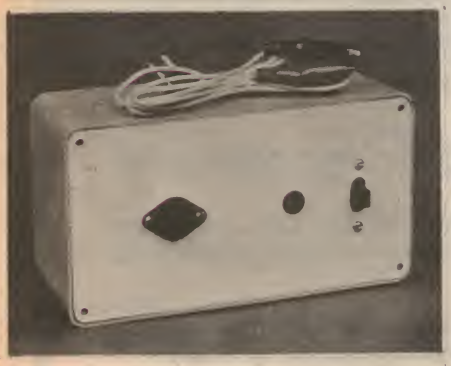
Recommended retail price is $399 including sales tax. Further information on Revox products can be obtained from the Australian distributors, Amalgamated Wireless (Australasia) Ltd, Engineering Products Division, 422 Lane Cove Road, North Ryde, NSW. (L.D.S.)

NEW PRODUCTS

Test aids for the Serviceman

Martin de Launay Pty Ltd have a range of three simple testing aids for the serviceman and hobbyist. They are a transistor / diode checker, shorted turns tester and television pattern generator. All are battery powered and use few components.

Each of the three units is housed in a compact plastic case measuring 160 x 88 x 70mm. There is no labelling on the control panel of each unit apart from rather cryptic symbols. Apparently, the manufacturer feels such labelling is rendered unnecessary because their simplicity makes operation straightforward and fairly self-evident.



On the front panel of the transistor-diode checker are two slide switches and three clip leads plus a LED indicator. The transistor base is connected to the centre clip lead while the emitter and collector connect to the other leads. The test considers the transistor as a pair of opposed diodes and merely checks each of the diodes for blocking in one direction and conduction in the other.

For the transistor to pass, the LED indicator must light up for both positions of the "junction" slide switch (adjacent to the clip leads) but only for one position of the polarity switch. Transistors can be tested for shorts between collector and emitter by connecting the emitter to the centre lead and the collector to one of the outer leads and checking that the LED indicator does not light up for any switch setting.

Diodes and silicon controlled-rectifiers can also be checked for go or no-go operation on this tester. Two penlight cells in the appropriate holder (not supplied) power the unit but we found that a nine-volt battery gives a better light indication

We feel that the polarity switch, if nothing else, should be labelled so that there is no need to refer to the instructions if the unit has not been used for some time.

The shorted turns tester is intended mainly for checking out television horizontal flyback transformers. The circuit consists of a one-transistor oscillator and a Darlington pair which monitors the oscillator output and drives a LED indicator. In use, the yoke deflection coils are disconnected and the tester is connected between the transformer top-cap connections for the horizontal output valve and the EHT rectifier.

If the LED is extinguished or is dimmed markedly, the EHT transformer is defective. This test is unambiguous and easy to perform. The instructions state that it can be used to test other types of high impedance inductors but we did not have the opportunity to try it.

The television pattern generator is the most complex device, comprising three TTL integrated circuits and a silicon NPN transistor. It is powered by three penlight cells and current drain is 60 milliamps.

In use, the television receiver is tuned to a station which locks the horizontal output to the correct frequency (15,625Hz). This is picked up by a white lead (from the pattern generator) dangled near the deflection components. The output lead from the generator is connected to the input of the video amplifier (luminance amplifier in colour sets) to swamp the received video information and provide the required pattern. Four patterns are available, selected by a rotary switch: horizontal bars, vertical bars, cross-hatch and dot pattern.

These patterns are useful for horizontal and vertical linearity adjustments and for convergence adjustments colour sets. We found the vertical bars and the dot patterns the most satisfactory. The crosshatch and horizontal bar patterns tended to be weak. However, these latter patterns are the least important of the four available.

We were not impressed with the standard of construction and would generally term it "flimsy". For example, in each case, the printed board is supported only by one of the switches. Perhaps most servicemen would not be worried by this aspect in view of the general simplicity of the instruments. Another complaint which applies to all three units is that the batteries or their holders are not secured within the case — they can rattle around and possibly do some damage to the internal components.

Recommended retail prices of the units are as follows: Television pattern generator, $27.60; Shorted Turns Tester, $15.33 and Transistor diode checker, $9.20. All prices include sales tax. Enquiries should be made to Martin de Launay Pty Ltd, 28 Clarence Street, Sydney, NSW.

At left is the transistor checker and below it the shorted turns tester. At right is the television pattern generator. All the instruments use the same case and have a very simple presentation.

Tagboard Shortage

According to reliable sources within the industry, double-sided resistor tagboard is going to be very hard to get by the middle of this year. This is apparently due to raw materials shortages. Kitsets Aust heard this and have come up with what they consider "the next best thing."

This is a piece of etched copper laminate, with pads and holes drilled exactly the same as a piece of tagboard. It could probably be used as a "drop-in" replacement. While the printed board version is probably not quite as versatile as the real thing, it should do in most circumstances.

The tagstrip is priced the same as conventional tagstrip, and is available at all Kitsets Australia branches.

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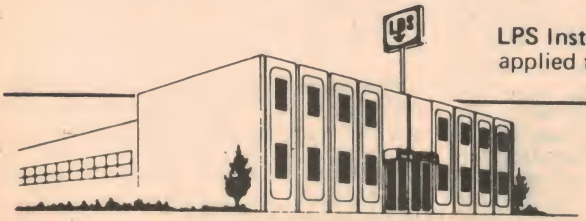

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NEW PRODUCTS

Labgear Colour Bar Generator

Tecnico Electronics have introduced to Australia a PAL Colour Bar Generator made by Labgear Ltd, England. Suitable for servicemen and technicians, it generates a variety of test signals from a compact package weighing only 2.27 kg.

Dimensions of the generator are 240 x 240 x 100mm, not including the rubber feet which tilt the control panel upwards slightly. Inside a single large printed board accommodates all the circuitry, which is comprised largely of dual in-line package integrated circuits. Power consumption is low at 8VA and the supply voltage can range from 200 to 250VAC 50Hz. Operating temperature range is 0-45 degrees C.

The RF output shielded cable, which terminates in a coaxial connector, is permanently attached to the rear panel so it cannot be lost. The same goes for the power cord. When not in use the cords are wrapped around the front metal feet. A retracting carrying handle is fitted at the side of the case.

Vision carrier is preset at 185MHz (Channel 7). The pattern generator can be used in conjunction with an oscilloscope for examination of receiver circuit waveforms and for this purpose an external sync socket is provided at the rear of the case.

Eight different patterns are available from the generator, selected by five push-buttons on the front panel. The first and most important as far as colour sets are concerned is the cross-hatch pattern, consisting of 14 vertical white lines and 12 horizontal white lines on a black background. This pattern can be used to check the overall geometry of the picture as well as the static and dynamic convergence.

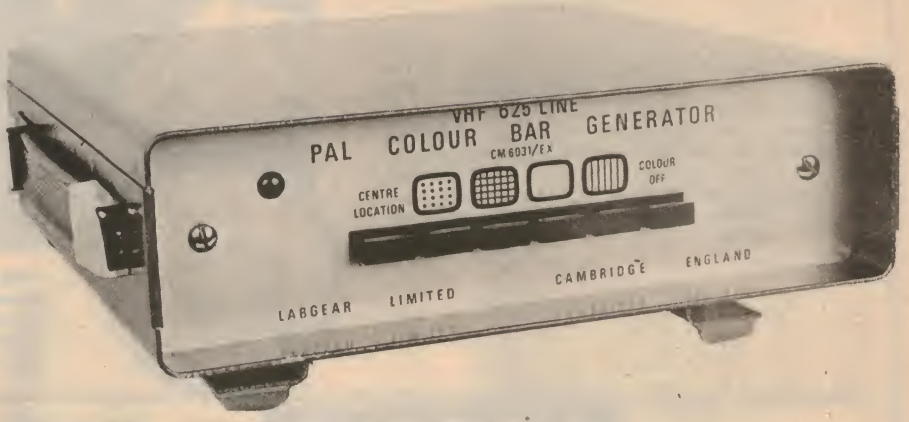
The cross-hatch pattern can also be used to check the amplitude response of the receiver. The vertical white lines have a width of several hundred nanoseconds. If these lines appear fuzzy and less bright than the horizontal lines, the amplitude response of the receiver is insufficient. If the vertical white lines appear "double" there is a ringing problem in the receiver circuitry.

By pushing the "centre location" button in conjunction with the cross-hatch button, one central vertical and one central vertical line are produced, which can be used for convenient picture centring.

A white dot pattern is also available which coincides with the intersections of the cross-hatch pattern. The dot pattern is intended for static convergence adjustments.

A red raster is available for checking colour purity without the inconvenience of having to turn off the blue and green guns. A white raster is also available by pushing the "Colour Off" button and this gives approximately 30 pc luminance level.

The colour bar pattern is the 75pc contrast and 100pc saturation type, with eight bars in the standard sequence: white, yellow, cyan, green, magenta, red, blue, black. Pushing the "Colour Off" button removes the chroma information to provide the standard grey scale bar pattern with eight steps from black to white.



The generator was connected to a large screen PAL colour receiver in our laboratory for test. We found it easy and straightforward to use and it generates precise, noise-free patterns. The width of the cross-hatch lines is appropriate and the same can be said for the dot pattern. On the colour bars, there was a small degree of overlap or "gaps".

We must add that it would seem preferable to have the vision carrier within the range of Channel 8, which would give minimum interference from local television stations. As it was there was a mild herringbone interference pattern on the screen, but this could be minimised with the aid of the receiver's fine tuning control.

Overall, our reaction is that the Labgear unit would be a very handy and convenient piece of equipment for use in the laboratory, service workshop, or in field service conditions. It is rugged, easily carried and its ease of use means that it would cause no problems to make it part of a routine test.

Further information on the Labgear PAL colour pattern generator can be obtained from Tecnico Electronics, 1 Premier Street, Marrickville, NSW 2204. (L.D.S.)

Books & Literature

FM, repeaters

FM AND REPEATERS, by the ARRL Headquarters Staff. First edition 1972. Published by the American Radio Relay League Inc. Soft covers, 240mm x 165mm, 232 pages, many circuits, diagrams and photographs. Recommended price in Australia $4.40.

Here is another valuable reference manual from the ARRL stable, this time dealing with the specialised problems of VHF FM communication — from an amateur point of view — and its logical extension into repeater systems using this mode.

There are 14 chapter headings, as follows: 1 — FM, Past and Present; 2 — The FM Concept; 3 — Receivers for FM; 4 — Transmitters for FM; 5 — Mobile and Portable Equipment; 6 — Antennas for Base and Mobile Stations; 7 — Repeaters; 8 — Repeater Controls and Accessories; 9 — Repeater Technical Problems and Cures; 10 — Testing FM Gear; 11 — Using Surplus FM Equipment; 12 — Tips on Buying FM Gear; 13 — Repeater Club Organisation; 14 — Operating Practices — FCC Rules.

Fairly obviously, some of the chapters deal with matters peculiar to the American scene and, as such, are of academic interest only in this part of the world. But these are in the minority and the bulk of the book contains a wealth of information for the VHF enthusiast.

The chapters on repeaters, in particular, should be of considerable value to any group contemplating a repeater installation. They deal with such items as cavity resonators, duplexers, control systems, timers, touch tone generators and decoders, and Morse code identifiers. (The latter section is quite large.) There are also discussions on aerials and aerial placement for best coverage and least mutual interference.

The review copy came from Technical Book and Magazine Co Pty Ltd, 289-299 Swanston St, Melbourne, Victoria, 3000, who advise that their price is $4.40, plus 50c postage to all states. (P.G.W.)

Radio servicing

FUNDAMENTALS OF RADIO SERVICING, Volume 2: Circuits and Servicing, by B. W. Hicks. Published by Hutchinson Educational Ltd, London, 1973. Soft covers, 185 x 240mm, 88pp, many illustrations. Price in Australia $5.40 ($9.00 hardbound).

The second volume in a series by the author written especially for the trainee or apprentice in radio and electronics servicing. It builds upon the treatment of basic principles given in the first volume, and aims at giving the would-be service technician a good grounding in typical radio receiver circuits — their basic similarities and functional equivalence, together with their divergence in terms of specific detail. The author is a senior lecturer in Radio and Television Servicing at Southgate Technical College in Middlesex, UK, and also an examiner for the City and Guilds of London Institute examinations.

The present book proceeds in methodical fashion from a historical introduction covering the chronological development of the radio receiver, through simple receivers, more complex receivers, FM receivers, car radios, record players and tape recorders. This basic progression is leavened with chapters dealing with testing techniques and alignment procedures, while the book itself ends with a collection of typical circuits for class study.

The text is clear and concise, and generally well served by illustrations. Some of these are at the rear of the book, a fact which the reader is left to discover for himself, a mildly irritating oversight. But in general, the book would seem to be well planned and produced, and together with volume 1 is likely to be found of considerable value by anyone seeking a good grounding in servicing techniques.

The review copy came from Hutchinson Group (Australia) Pty Ltd, of 30-32 Cremorne St, Richmond, Victoria. Copies should be available from all major bookstores. (J.R.)

TRANSISTOR INTERCHANGEABILITY GUIDE, 1973, published by Elcoma, the Electronic Components and Materials division of Philips Industries Ltd. Soft covers, 210 x 297mm, 13pp. Price in Australia $1.00.

The latest edition of this useful servicing guide, which gives the nearest "Miniwatt" transistor equivalent to a considerable number of Japanese types with numbers in the 2SA, 2SB, 2SC and 2SD series. It also gives abridged data for all of the Miniwatt devices recommended in the interchangeability guide.

Almost essential for anyone servicing Japanese equipment. (J.R.)

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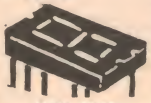

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The Amateur Bands

by Pierce Healy, VK2APQ

More Amateur Publicity Needed

When compared with the sensational headlines in the daily news media, very skimpy publicity results from amateur achievements, or the services rendered by amateurs to the community.

The truth of the above hit home while contemplating the prospects of amateur radio improving, or even maintaining, its present status against pressures by other interests.

It was equally obvious how difficult it is to get amateurs to talk about, or write about their technical achievements or services in emergencies. Especially before these become dated as useful news items.

Such diffidence is too often classified as modesty when, truthfully, it could be a lack of confidence in ability or convictions. While modesty may be an admirable trait, both causes can be detrimental when amateur radio is in need of good publicity.

Amateur radio needs all the good publicity it can get, in order to withstand the pressures on its bands, particularly VHF and UHF. Gone are the days when sentiment and nostalgia ranked high in places where claims by commercial and other interests are assessed.

It is interesting to recall some recent, current and continuing activities involving Australian amateurs, under the heading "Achievements and Service".

It is this type of activity that we should record — as an acknowledgement of the achievement and to present a true image of amateur radio to the public.

These achievements are not given in any order of merit and the comments do not attempt to compare their importance or value.

Amateur Satellite: OSCAR VI has been in orbit for more than 12 months. It carries units designed and built by Australian amateurs. This satellite provides free communication facilities to all amateurs, irrespective of nationality. On a worldwide per capita basis, Australia ranks second in the number of stations making contacts via the satellite. AMSAT — OSCAR B, (OSCAR VII) will also carry Australian amateur designed and built units.

Earth-Moon-Earth: Moon bounce experiments on 1296MHz; 432MHz and 144MHz bands have been very successful in the past year, producing world distance records for 1296MHz and 432MHz, and Australian distance records for 144MHz. Geographically, it is not possible for Australia to better the world 144MHz record, at present between New Zealand and Sweden.

VHF-UHF communication: Experiments between ground based stations on 10GHz, 2.3GHz, 432MHz, 144MHz and 52MHz have produced interesting results. New Australian records in world class, have been set. Inospheric, tropospheric and meteor scatter tests have enabled useful propagation data to be compiled. In general only home built equipment has been used. Experiments in both GHz bands have used portable equipment in the field. Further records are expected to be made in the near future.

Beacons and Repeaters: Beacons on 52MHz, 144MHz and, to a lesser degree, on 432MHz, are maintained in most Australian States. These beacons provide both a ready signal source on a known frequency, and a means of checking band conditions during various atmospheric phenomena. Repeater stations in the two metre band, are widespread, particularly in the major cities and where extended VHF communication is desirable.

These installations also provide links between fixed stations beyond their normal area of coverage. Although free access is available to all amateurs, the installations are maintained by WIA appointees or groups affiliated with the Institute. The major portion of the equipment is obsolete commercial units modified for amateur requirements. All identification and switching equipment has been designed and built by amateurs, using many solid state techniques.

An interesting point is that many of the locations now used for microwave telephone and television repeater links were initially used by amateurs during field day VHF and UHF experiments.

Standard and Slow Scan TV: There are small groups experimenting with TV and producing good quality pictures over paths up to 150Km. Outdoor telecasts have been made of field day events using portable units, and several stations are experimenting with colour.

Slow-scan TV is popular on 14MHz and an increasing number of Australian stations are exchanging pictures with overseas stations. This mode appears to be used solely by amateurs.

A large number of amateurs are employed in commercial TV and allied industries.

Emergency Services: The value of the Wireless Institute Civil Emergency Network (WICEN) has been proved in many emergencies, providing links between disaster areas and relief centres until official channels were set up. In many instances WICEN stations have been integrated into the official network. Many amateurs are members of civil emergency organisations, using their skill to man communication centres.

Very seldom is the full story of amateur emergency activity fully reported. Yet everyone, including the press, turns to the amateur for help when the normal communication links fail.

Special events: Maintaining communication with individuals or groups travelling to some remote location, either on land or at sea.

The most recent activity was maintaining communication with the "La Balsa" expedition. Communication throughout was via amateur radio.

Prior to the voyage plans were made for a controlled network of amateur stations. These maintained contact with the expedition until their safe arrival in Australia.

Even when it was necessary to enlist the Royal Australian Navy to tow the rafts to a port, radio contact with the navy vessel was on the amateur net frequency.

Success of the communication net was entirely due to the flexibility of amateur radio and the ability of amateurs to get things done.

A tribute to the amateur operators was expressed by the radio officer of the naval vessel.

"I have operated under many different types of control systems, but never before have I run into an organisation so efficient or so quick to get things done as on this trip. I was delighted with the procedure, quick response and complete understanding between stations; it made our job so much easier and resulted in a much quicker recovery of the rafts than would have been possible under most other methods of control."

The story of the expedition was published in the WIA magazine "Amateur Radio," December 1973 and January 1974 issues.

Monitoring services: Amateur radio is unique in that it is a self disciplined communication service; amateur representatives are members of the PMG Department's advisory committee which monitors amateur stations. Another entirely amateur organisation, Intruder Watch, reports any breaches by commercial services operating within exclusive amateur bands. These have resulted in many of the interfering signals being removed after the complaints have been confirmed by the PMG's own monitoring stations.

Educational facilities: For persons wishing to study for the amateur licence examination, theory classes and Morse code practice sessions are available at WIA divisional centres or at affiliated radio clubs. Correspondence courses are also available.

In addition there is the Youth Radio Club Scheme, sponsored by the WIA, to encourage the youth of the community to improve their knowledge of radio and electronics generally.

YRS clubs in schools have assisted students in their physics and science studies, as well as providing a hobby or starting them in a career in electronics. YRCS examination certificates are accepted by employers as an indication of the holder's aptitudes.

This scheme is an asset to the community; one which augments normal education facilities.

These are just a few facets of amateur radio which, if not stifled by unappreciative administrations or demands of commercial interests, will continue to provide a continuing source of knowledge and service to the world.

Admiral Don Samuel Fernandez, XE1EB, operating station VK2SG/P4 from the home of Dr Win Fowles at Mooloolaba, Qld, in contact with the "Las Balsas" rafts off the Queensland coast. (See story page 106).

IARU NEWS

The The World Administrative Radio Conference for Maritime Mobile Telecommunications will open in Geneva on 22nd April 1974. The International Amateur Radio Union is invited to participate in ITU conferences and Region I division will, on this occasion, represent the IARU.

It is expected that committee members, Roy Stevens, G2BVN, secretary, and W. Nietyksza, SP5FM, committeeman, will be present and, if required, Axel Tigerstedt, OH5NW.

It is not expected that the agenda will contain matters of importance to amateurs, but this cannot be taken for granted. It is essential that amateur representatives be present.

ITU Conference

The next World Administrative Radio Conference will be held in 1979. All allocations from 10KHz to 275GHz will come under scrutiny, including all amateur bands. If the amateur service is to withstand the pressure that will be brought upon it, worldwide cooperation is essential.

Region I

The next Region I Division IARU conference is to be held in Warsaw, Poland in 1975. Consideration of the ITU WARC will be a major item on the agenda.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown, 2200.

AMATEUR BANDS

South Africa: The South African PMG has announced a restricted licence for use above 144MHz, requiring normal licence qualifications, less the Morse test.

Crossband operation will not be permitted where part of the communication (including a satellite) operates below 144MHz. Call signs will have the "ZR" prefix.

Region II

USA: Requests by citizen band equipment manufacturers to the FCC to allocate part of the 220MHz to 225MHz amateur band for a new class of citizens radio service, have been vigorously opposed by the American Radio Relay League.

The ARRL has recommended the following to the Commission:

1 — Withdraw the proposal to establish a new service in the 220MHz to 225MHz band or elsewhere other than 25 MHz to 27.5 MHz.

2 — Issue a notice of a proposed rule requiring; (a) all new 27MHz class D transmitters manufactured and sold after 1st January, 1975, to be (SSB) and (b) termination of all AM operations by 1st January, 1977.

3 — Invite suggestions for implementing recommendations for improved channelisation of the Class D service.

If the proposal to reallocate the 220MHz band is not withdrawn, the ARRL requests oral discussion with the Commission on the proposals.

Region III

At the time of writing there was no information regarding the next Region III Association conference. At the 1971 conference in Tokyo an invitation was extended by the Hong Kong Amateur Radio Transmitting Society (HARTZ) to hold the 1974 conference in Hong Kong.

Late in 1973, following the resignation of Peter Williams, VK3KZ, David Rankin, VK3QV, took over as secretary of the Region III Association.

New Zealand: In the December, 1973, issue of "Break-in" there appeared a thought provoking article by Tom Clarkson, ZL2AZ, Region III representative. Entitled "Amateur Radio — The Preservation of its Rights to Operate" the article gives details of the stand and views expressed by nations at the Space Radio Conference in Geneva in 1971. Tom states that the special message to amateurs arising from the deliberations was that "in the world today, there is no majority opinion favourable towards the amateur service".

This article should be regarded as essential reading by all amateurs, particularly more youthful members who aspire to become members of various club committees and divisional councils. Also to those who look to the continuation of the amateur service with at least the rights and privileges available today.

Australia: The WIA annual federal convention will be held in Sydney, NSW, over Easter weekend 12th to 15th April, 1974. The venue is the Auburn Motor Inn. A combined NSW division and convention dinner will be held at the venue on Saturday night, 13th April.

All WIA members have been invited to submit agenda items. Such items should relate to the overall operation of the Institute at the federal level, matters of policy concerning Institute activities, or matters that may affect amateur status at international level.

It is believed that the ACT VK1 call area will be formally accepted as a WIA division.

A proposal for proportional representation (according to numerical strength) for each division is expected to be raised by the Victorian division. The present one vote per division at federal conventions, adopted in February 1972, was a Victorian division proposal.

The convention is open to any WIA member who may wish to attend and observe. New Zealand visitors, members of the NZART, are expected to be present.

India: Through the recently formed Federation of Amateur Radio Societies of India, amateur radio is receiving substantial government and industrial support.

A new high power transmitter was given to the Radio and Electronic Society of India by Vibronics Pty Ltd, for Morse code practice sessions as part of a drive to increase the number of amateurs. To inaugurate this service, Mr M. K. Basu, VU2 XM, wireless adviser to the Indian Government, made a special trip from Delhi to Bombay. The occasion also celebrated the 50th anniversary of amateur radio in India.

Some very encouraging results have been achieved through the Morse code sessions. It has enabled pupils in remote villages to participate, using transistor radios.

The FARSI has embarked on a program for expanding the interest in amateur radio in schools and colleges.

RADIO CLUB NEWS

It appears that the Christmas holidays had a marked effect on many radio clubs, as the amount of news coming to hand was much smaller than usual.

Most Youth Radio Clubs suspended activities until the resumption of school terms. Club organisers are reminded that they should register with the WIA Youth Radio Club Scheme Supervisor in their respective states. (See "Electronics Australia" January 1974 Page 97.)

Central Coast Amateur Radio Club

The repeater committee has issued a comprehensive set of notes on operating conditions and facilities available through the club's FM repeater, VK2RAG channel 1.

Located at the Kariong club rooms, south of Gosford, 173 metres above sea level, the repeater is intended to cover the Shires of Gosford and Wyong. This it does fairly well with some shielding to the south due to the Hawkesbury region terrain.

In addition to the timers, etc, required by PMG's Department, several other facilities have been incorporated. These include frequency and deviation check of the incoming signal.

A copy of the instructions may be obtained from the secretary, Central Coast Amateur Radio Club, PO Box 238, Gosford, NSW 2250.

Geelong Amateur Radio & TV Club

Six and two metre activity was very high in Geelong at the beginning of January. Several long haul contacts were made via sporatic-E and tropospheric paths.

All states and all New Zealand call areas were worked on six metres, but many operators expressed disappointment at the lack of interest by the ZL operators in trying to work two metres while the six metre band was open.

On the 8th January, 1974, Daryl St John, VK3AQR in Geelong and Geoff Wilson, VK3AMK, worked Lance Bickford, VK4ZAZ, in Rockhampton on sex metres at good signal strength. They then changed frequency to the two metre band and exchanged 5 and 9 reports.

The opening lasted 45 minutes, during which time Mike Trickett, VK3ASQ, also made contact with VK4-ZAZ.

It is reported that around the same period, Geoff Wilson, VK3AMK, worked several stations in and around Perth at strength 4 on two metres. No other details are available.

During a camping trip to Mount Cowley, 129 kilometres south west of Melbourne, five members of the GARC headed by Mile Trickett, VK3ASQ, and Peter James, VK3ZOS, made over 400 contacts between 28th December, 1973, and 2nd January, 1974, on 52MHz, 144MHz and 432MHz, SSB in all cases.

The highlight was on New Year's day. All Australian states and three New Zealand call areas were worked on 52MHz. The contacts included 13 VK6 stations.

Other contacts reported for the same period were: 30th Dec, 1973 — VK4ZEL to VK5MC: VK4ZEL to VK3AOT / P3. 2nd Jan, 1974 — VK5ZWW to VK2 (Sydney area).

Stations in Southern NSW and ACT interested in regular contacts with Geelong stations are invited to contact VK3ASQ, VK3AQR or VK3ZNJ via the GARC, PO Box 520, Geelong, Vic, 3220.

West Australian VHF Group

The Wireless Hill museum project now needs assistance to restore and repair exhibits. John Watson, VK3JW, is working almost full time on the task.

A PDP6 computer has been donated to the museum by Digital Equipment Corporation. This is of considerable historic value. Group meetings are held on the fourth Monday of each month in the Wireless Hill Museum Building at 8.00 pm.

Maitland Radio Club

The Maitland Radio Club will hold its first major field day on Sunday, 31st March, 1974, at the club headquarters in Maize Street, Tenambit, East Maitland.

Activities have been arranged for amateurs and non-amateurs in all age groups. They will include, transmitter hunts, ladies' events and treasure hunts for the younger people. Morning and afternoon tea will be provided.

Members Garry Watson and Phillip Lawrence have qualified for the YRCS radio telephony certificate. They are the first club members to gain that award.

A new syllabus is being arranged to update the club's training program. The new program will be conducted at three stages; an elementary class, a junior class and an advanced class.

Visual aid training with demonstration units, slides and movies will be a feature of the new system.

For further details contact club secretary — Allan Watson, PO Box 59, East Maitland 2323. Telephone Maitland 37 2282.

IONOSPHERIC PREDICTIONS FOR MARCH

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Commonwealth Bureau of Meteorology. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 3.74

LOCAL & OVERSEAS NEWS

At the January WIA NSW division meeting Sid Molen, VK2SG, communication co-ordinator for the La Balsa expedition, gave a very interesting talk on the part of amateur radio as the rafts crossed the Pacific Ocean.

Sid illustrated his talk with a large map on which he had plotted the rafts' location at each scheduled contact, generally every four days. The map had been autographed by the 12 members of the expedition.

Also of great interest was the FT101 SSB transceiver used on the voyage and presented to Sid by the expedition leader, Vital Alsar, as a token of their appreciation. The unit bore the signatures of the twelve members.

Colour slides of the rafts at sea and on their arrival at Ballina, together with shots of personalities, added to the enjoyment of the talk.

A distinguished visitor present to welcome the expedition was Admiral Don Samuel Fernandez (ret), XE1EB, navigation instructor to the Mexican Navy, who had taught Vital Alsar and his crew how to navigate and who had assisted greatly in the organisation of the voyage.

Handicapped Operators

An item appearing in the December, 1973, issue of the NZART "Break-in" should interest those who operate CW on the 7MHz band, particularly if the call WN2KPU appears in their log book.

Timmy Bilson, who holds that call sign, was born just 15 years ago without arms and only parts of his legs. A greater part of his life has been spent in the Philadelphia and Springfield Shriners' Hospital where he has been fitted with an electric wheelchair which he controls by means of chin pressure applied to a panel attached to the vehicle.

Tim uses his left foot, which is very much abbreviated, to operate a Morse key. His school grades are equal to the highest in his class. He must lie on the floor to perform his school work using his left foot.

George England, ZL2LT, is a quadriplegic and as he is unable to use his hands, steers his chair with a forehead wand. George is quite an efficient operator on phone and is noted for his patience particularly when a number of stations call him.

27MHz Clamp Down

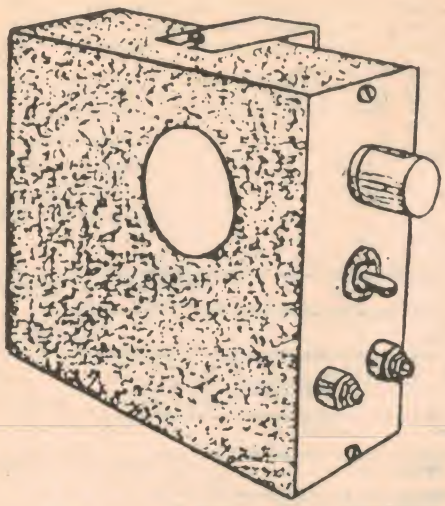
FCC action against operators on the 27MHz citizens' band appears to be gaining momentum following the use of special monitoring teams throughout the country.

For charges including unlicensed operation, hobby type communications, communications with unlicensed stations, superfluous communications and failure to limit communications, suspended sentences of six months with fines of up to $300 and probation periods have been imposed.

In another case, for violating the Commission's rules, a fine of $500, a suspension, and a probation period of three years was given. For transmitting obscene language from mobile citizens radio stations and on charges of conspiracy, several have been indicted by a federal grand jury.

Another indictment by a federal grand jury was made for issuing a threat, over a citizen band radio station, to injure an FCC engineer.

(A)



SHOPLERT

The most revolutionary shop doorway minder to ever appear on the market.

Uses NO light beams — works on a sudden variation of room light. ie when someone walks in front of it. Range approx 10 feet. Battery operated — takes 6 penlite cells. Replace batteries only 2 to 3 times a year. Built in speaker produces adjustable loud or soft tone. Whole unit is self contained and can be fitted by ANYONE in minutes. No external wiring needed. Provision for remote extension. Thousands sold in NZ. Replaces every other shop alarm on the market. Complete and ready to go (minus batteries).

$29.40 each or 4 for **$99.00**

(B)

HOMODYNE TUNER KITSET

(from Electronics Australia) Complete with attractive anodised cabinet and silk screened front. **$23.00.**

(C) BARGAIN PACK

$100 worth of brand new electronic components of all sorts, shapes and sizes. This is our biggest selling pack in NZ. You'll be overjoyed with the selection — for only **$23.00.**

(D) BC409

This is a plastic encapsulated version of the BC109, preferred by manufacturers due to its lower cost. Supersedes the BC109. This is NOT a substitute or equivalent, but the identical same transistor chip. Well known brand.

4 for **$1.00** or 10 for **$2.00**
or 100 for **$18.00.**

(E) ASSORTED ELECTROLYTICS

Pack of 20 assorted electro's. Ranging from 2500uf at 40v right down to small values. Retail value $14.00.
Our price **$5.90** per pack.

(F) BRIDGE RECTIFIER

100P.I.V. at 1.5 amps. Well known brand.
$1.00 each or 10 for **$8.50**
or 100 for **$75.00**

(G) POWER DIODE

200 volts at 2 amps. Well known brand.
5 for **$2.00** or 10 for **$3.50**
or 100 for **$30.00.**

(H) VHF KITSET

One transistor, super regenerative, receives Police, taxis, aircraft, etc. Pictorial instructions. Works through an ordinary transistor radio without connecting wires. Heap big magic, eh! ONLY **$4.90**

(I) L.E.D.

Light emitting diode — used as indicators in transistor work. Hewlett Packard part no. 5082 / 4850.
Supplied with panel mounting hardware — draws only 20 ma. Operates as low as 1.6 volts. Data supplied.
70c each or **5 for $3.00**

(J) 40841 FET

A popular diode protected dual gate FET — can be used in place of almost any other FET. Data supplied.
$1.00 each or **10 for $8.00**

(K) 20 CIRCUITS AND 12 SEMICONDUCTORS

20 of our most popular circuits and 12 semiconductors, including BC409, AC187 / 88, AC125, OA95 etc. Never before released by us. **ONLY $4.90.**

(L) ONE TRANSISTOR RADIO KITSET

Can be assembled by any child from 8-108. Only a screwdriver required (and a band-aid). No soldering necessary. Coil already wound and mounted (in a funny sort of way). Easy to follow pictorial instructions (my 3 yr old daughter drew them). All parts coded for identification (morse coded). The biggest selling radio kit in NZ (well, Wellington anyway). Complete with super high impedance hi fidelity personal earphone (ie we bought 'em cheap).

Attractively mounted in a see through poly bag (we couldn't afford a carton).

IF YOU'RE WILLING TO TAKE THE RISK — IT'S YOURS FOR **$4.60.**

Over the years we've built 3000 — we've only got 2900 left — be in quick before the borers set in.

	qty		qty		qty		qty		qty		qty
A:		B:		C:		D:		E:		F:	
G:		H:		I:		J:		K:		L:	

I enclose cheque / money order, including 50 cents extra to cover postage.
We regret that due to currency regulations we cannot accept personal cheques.

NAME:.....

ADDRESS:.....

Send this coupon to

WELLINGTON **KIT PARTS LTD** CHRISTCHURCH
ALL RADIO COMPONENTS

P.O. BOX 27 037, Wellington, New Zealand.

MONEY BACK IF NOT COMPLETELY SATISFIED

Shortwave Scene

by Arthur Cushen, MBE

WYFR operated by Family Radio is a new gospel radio now broadcasting to Europe, Africa and America, having purchased the facilities of the former WNYW New York.

The new WYFR has had a long history as far as its facilities are concerned, as the station had its beginnings in the early 1930's as W1XAL in Boston. It was then known as University Radio and the transmitters were, and still are located at Scituate, Massachusetts. Later the call sign was changed to WRUL and the studios moved to New York; later still the station became WNYW, known as Radio New York World Wide. We have verified this station throughout its history and now, under its new call sign, it is being heard well by listeners. WYFR uses four transmitters and nine directional antennas on 28 acres.

The new owners, Family Radio have a network of FM Gospel Stations, and this is their first venture into International Broadcasting. The mailing address for reports is: Family Stations, Inc, 290 Hegenberger Road, Oakland, California 94621.

The present schedule of WYFR is:

To Europe		To Africa	
GMT	kHz	1700-1945	21525
1700-1800	21525	2000-2200	15130
1700-1930	17845	To Caribbean	
1700-1930	15440	1945-0030	17760
1815-1945	15130	2315-0230	15215
1930-2300	9690	0015-0230	11855
2000-2215	11895	0045-0230	9715
2230-2400	6075	0045-0230	5985

ASIAN DX REPORT

The popular Radio Nederland DX Juke box program includes an Asian DX report as from last month, and this is broadcast on the fourth Thursday of each month. DX Juke box is heard at 0645 and 0815GMT on 11730 and 9715kHz respectively through the relay station at Bonaire, and is repeated in eleven other transmissions. The present line-up of reporters is:

1st Thursday: — Pacific DX Report, with Arthur Cushen.

2nd Thursday: — Scandinavian DX Report, with Jan Tuner.

3rd Thursday: — North American DX Report with Glenn Hauser.

4th Thursday: — Asian DX Report with Gregg Calkin.

5th Thursday: — European DX Council progress reports with EDXC Secretary General Wolfgang Scheunemann.

Gregg Calkin, a Canadian DXer of long experience who is now stationed at Islamabad, Pakistan, takes over the fourth Thursday session from Maarten van Delft, who for many years has conducted the Benelux DX Report. Radio Nederland is well aware of the tremendous growth in short-wave listening in Asia and has made this change.

Commencing this month, Radio Nederland is broadcasting a special series "Radio Components' Course," as part of the DX Juke box program. Full details are available from Radio Nederland P.O. Box 222, Hilversum, Holland. The course is designed to attract non-technical listeners, meeting a demand for information on all sorts of radio components, their functions, and interaction.

SAHARA VERIFIES

Undoubtedly the most interesting verification to be received in our mail in the past few weeks was a verification from Radio Sahara, broadcasting on the medium-wave frequency of 656kHz and with the power of 50kW. Reception was at dawn in September, when the equinox conditions enable signals from North Africa and Europe to be heard in Australia and NZ.

Radio Sahara was our 138th country to be verified and our 2127th MW verification. According to a letter from the station they operate on medium-wave on 656kHz with two transmitters, one of 50kW and the other 5kW; on 998kHz they use 10kW. On short-wave the transmitter on 7230kHz uses 10kW and on 4626kHz the power is 5kW. Spanish broadcasts are from 0559 - 0800, 1100-1900, 0100-0115. Broadcasts in Hassanfa and Arabic are on the air 0800-1100, and 1900-2400GMT.

FEBA USES 100kW

The Far East Broadcasting Association at Seychelles has advised us that they hope to have their new 100kW transmitter in operation this month. The station commenced operation in late 1969 using 3kW. Later the power was increased to 30kW and a new antenna system erected on the reef to concentrate signals into Asia and Africa. We have recently been hearing the transmission in English up to 1800GMT and in Arabic to 1900GMT on 1189kHz. According to a verification the English programs are as follows:

GMT	kHz
0600 — 0845	15270, 17800
1530 — 1645	11890, 15330
1745 — 1800	11890, 15330

Address of the station is: The Far East Broadcasting Association, Box 234, Mahe, Seychelles.

KGEI EXPANDS SERVICES

Station KGEI, "The Voice of Friendship" at San Francisco, has for many years been operated by the Far East Broadcasting Company, which is located at Manila and has transmitters in Korea and Seychelles.

Recently KGEI commenced a service to the Far East and this expanded service has been widely reported. A new transmitter of 250kW is soon to be introduced. Transmissions on 9585kHz are in English up to 0900GMT and then in Russian. At 1000 GMT a frequency change is made to 9520kHz with broadcasts also in Russian. Our reception has been spoilt by Radio New Zealand on this frequency.

Another new frequency is 15170kHz, which has been heard by John Mainland of Wellington at 2000GMT; the old channel of 15280kHz is heard at 2230GMT, and at 0210GMT the station is using 9615kHz.

Our reception of KGEI on 9615kHz has been up to sign-off at 0700GMT, when they conclude a service to Latin America. According to the announcement they return to the air at 2145GMT on 15280kHz. The station asks for reception reports to KGEI, The Voice of Friendship, PO Box 15, San Francisco, California, 94101, USA. Bryan Clark of Wellington NZ reports reception around 0600GMT on 9615kHz, but at this time some jamming, and sideband interference from Saudi Arabia on 9610kHz, is evident.

INDONESIAN VERIFICATIONS

Two interesting verifications have been received from Indonesia. One is from a new station, Radio Republik Indonesia at Bengkulu, which was heard on 4045kHz. This station was heard at 1300GMT with a relay of news from Jakarta. The verification gives the power as 1kW and the schedule 2300-0100 and 1000-1600GMT. The verification was in Indonesian.

Radio Pemerintah Daerah operates on 4650kHz and closes at 1600GMT. According to a verification card they also use 3430kHz. The schedule on 4650kHz is 2325-0200, 0630-0745, 0925-1130, 1215-1300GMT, but it is known that the schedule has been running as late as 1600GMT. The Station address is P.O. Box No 25, Pematangsiantar, Sumatera, Utar, Indonesia.

Further details on other stations, and information on what is being heard by readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT, add 8 hours for WAST 10 hours for EAST and 12 hours for NZT.

ISRAEL EXPANDS BROADCAST

In the past few months, the Israel Broadcasting Authority has expanded its short-wave service, increasing the number of transmitters and their power to give them world-wide reception. They have also introduced a session "Calling all Listeners," which is broadcast on Saturday at 2030GMT and in which letters from listeners are answered.

There are three main English programs each day from Jerusalem which are broadcast as follows:

GMT	kHz
0500-0515	9009, 11725, 11745, 15140
1130-1200	15100, 15130, 17720
2000-2045	6175, 7280, 9009, 9785, 10250, 11700, 15245 15400.

A frequency outside the regular broadcast bands of 9009kHz has been used by Israel for some years, but they have now introduced another channel, 10250kHz. This frequency is used in French, 1200 — 1230, 2200-2300; in Russian, 1530-1615GMT.

TESTS FROM SAUDI ARABIA

During the past few weeks reception of test transmissions from the Voice of Saudi Arabia, at Riyadh have been reported throughout the world. It is understood that four transmitters, each of 500kW, are being used, as well as rotatable and curtain aerials.

The test transmissions have been in Arabic with announcements in English every 30 minutes; frequencies from the 49 to the 13M band have been used. At 0500GMT 9610kHz provides the best reception, while later broadcasts are observed on 21510kHz at 1000GMT, around 1900GMT on 11890kHz, and after 2000GMT on 11775kHz.

The station is asking for reception reports to the Engineering Department, Ministry of Information, Riyadh, Saudi Arabia.

CANADA USES RELAYS

Radio Canada International, as well as using its transmitters at Sackville, has its programs rebroadcast by the BBC and Trans Europe. The program format of Radio Canada in its service to the South Pacific has also been changed, with the Short-wave Club program now broadcast on Saturday at 0915GMT. Frequencies remain the same, 5970 and 9625kHz, and the transmission time is 0830-0930GMT.

The tentative schedule, which comes into effect on March 3, shows the use of the two relay stations as follows:

Transmissions from BBC Daventry are:

GMT	kHz
0315-0345	6015, 7285
0600-0630	6110,7210, 9515
1445-1645	11935, 15315
1715-1945	7235
1715-2015	5995
1945-2015	7225

Broadcasts of Trans Europe Sines, Portugal

0345-0400	6015, 7285
0330-0400	9615
1445-1600	11970, 15160

LISTENING BRIEFS

EUROPE

FRANCE: Bob Padula of Melbourne in the ARDXN reports reception of Paris on the new frequency of 6010kHz. A news bulletin in German was heard in the transmission at 1800GMT; this service to 1845GMT appears to be a new broadcast.

GREECE: The Greek Armed Forces Radio at Athens is again using 6044kHz and is heard on Sundays with a religious service at 0650GMT. John Mainland of Wellington reports reception of this transmission as early as 0550GMT. Athens Radio, in its service to Australia in Greek, is well heard on 21460kHz opening at 0800GMT, according to Paul Frost of Tauranga, NZ.

HUNGARY: Radio Budapest is using the new frequency of 6110kHz at 1630GMT according to the ADXN. There is interference on the frequency.

ASIA

JAPAN: Radio Japan in Tokyo has a daily transmission to this area from 0930 to 1030GMT and uses two frequencies: 11875 and 15235kHz. On Sunday they have a four minute DX Corner program after 1000GMT, which includes interesting items supplied by the Japanese Short-wave Club.

TAIWAN: The Voice of Free China at Taipeh using 17785kHz is giving good reception in their English service to 0320GMT. This hour-long transmission is beamed to the United States, but generally gives good reception in the South Pacific.

THAILAND: The Bangkok Meteorological Radio is using 7863kHz from 0000-1330, according to the bulletin of the Union of Asian DXers. The station has been heard in this area from as early as 1100GMT with weather information in Thai and English. Full details are given at 1330GMT when closing, including the fact that 11645kHz is also in use.

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General Features

Theory

Elementary Electronics

Forum

Circuit and Design Ideas

Constructional Articles

Regular Features

ELECTRIC CAR FAN

Latest model electric car fan, which plugs into the cigarette lighter on your car; has 4" blades. The base acts as a suction cap to fix it to your dash; also bracket for mounting on wooden base. Available for 6 volt and 12 volt cars. Specify the voltage required when ordering.

Packed and posted $4.75. Complete with wire & plug.

Order now, limited stocks.

4-SPEED RECORD UNIT

"Ambassador" 4 speed 16, 33, 45 & 78 rpm stereo phono unit, complete with Ronette pickup. Stereo ceramic cartridge and stylus for LP and 78 records.
Packed ready to mount with screws and template for installation.

Instructions for connecting to amplifier or radiogram. 240V AC mains operated.

Posted NSW $16.50. Posted Interstate $17.00.

Reduced from $25.00. Special Offer.

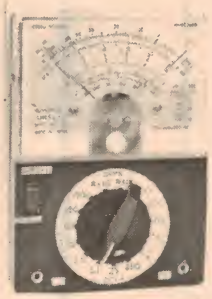
Order now, limited stocks.

NEW RH (Radio House) RANGE OF MULTIMETERS

MODEL RH-60 $29.00 Packing & Postage $1.00

50,000 Ohms per Volt DC.
10,000 Ohms per Volt AC.
Specifications:
DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 25uA, 5mA, 50mA, 500mA
Resistance: 10K, 100K, 1M, 10M.
Decibels: —10 +62dB.
Accuracy: DC ±3 p.c., AC ±4 p.c. (of full scale).
Batteries: Two 1.5V dry cells. Overload protected.

"HANDYMAN" RH150 $14.75

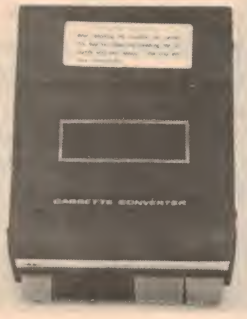


CHECKED PACKED & POSTED $15.50
Pocket-size 3¼" x 4½" x 1¼". Instruction sheet and circuit.

SPECIFICATIONS:
DC Volts: 2.5, 10, 50, 250, 1000. 10,000 ohms per volt
AC Volts: 10, 50, 250, 500, 1000.
DC Current: .1, 25, 250mA.
Resistance: 20K and 2M.
Decibels: —20dB, +62dB, 0.7KHz.
Capacitance: .0001, 01, .0025, 25uF

NEW MODEL NA — 100 CASSETTE CONVERTER

PRICE: **$35.00** Pack & Post $1.00.
Play your cassette tapes through your car Radio and speaker and save **$30.00** to **$40.00**
SIZE 6" x 4½" x 2⅛"
Complete with fittings and instructions to install in any car which has a radio fitted. Radio can also be operated when required. This model reproduces the excellence of music from a cassette through the AM Car radio. Operation is extremely simple.



WORLD RANGE SOLID STATE DELUXE RADIO "LONGINES SYMPNONETTE"

19 TRANSISTORS — 9 Diodes — 500 MW output.
SIZE 11" x 13" x 5"

FEATURES:—
1. Tuning knob
2. Fine tuning knob
3. On-Off push Switch
4. Volume Control
5. Tone Control
6. Squelch Control
7. Band selector knob
8. Time zone
9. Telescopic antenna
10. Dial light
11. AC / DC selector
12. Extension Antenna Jack
13. Earphone Jack

This new Solid State Radio is all-band, all transistor portable designed for super sensitive reception of Amplitude Modulation (AM) Marine Band (MB) International Short Wave (SW1, SW2) Frequency Modulation (FM) Public Service Band LOW (PB), AIRCRAFT (VHF1) High Public Service Band (VHF2) and Weather Band (WB).
These Bands will provide you with many hours of entertainment and excitement. This radio is also equipped for house electricity (240 AC) as well as by batteries (4 "D" cells).
PRICE:— **$135.00** pack & post $1.50.

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INFORMATION CENTRE

AMPLIFIER PROBLEM: Having completed and carefully checked the Playmaster 136 stereo amplifier (December 1972 and January 1973) I was somewhat disappointed on switch-on to be greeted by a 100Hz "raspberry" for a period of approximately 1 second. The noise occurs each time on switch-on and then decreases until it disappears, presumably as the large capacitors in the power supply are charged.

The noise can be eliminated by fitting a pair of resistors, each having a value greater than 4.7 ohms, in series with the transformer secondary winding. However, the noise re-occurs if these resistors are reduced to a value below 4.7 ohms. I would appreciate your advice as to what could be causing the noise. (K.F. Springfield, SA.)

From the symptoms described, it would appear that there is an earth wiring problem in the amplifier, the noise being caused by peak current surges into the filter capacitors at switch-on. We would refer you to the January 1973 edition of "Electronics Australia" where the earth wiring was discussed in some detail.

To be more specific, your particular problem is probably due to a spurious connection between the "earthy" pattern of the power amplifier module(s) and the chassis, and/or high resistance in the earth contacts between the two amplifier boards. The first possibility may be eliminated by slightly countersinking the board mounting holes with an oversize drill so that the copper pattern cannot make contact with the mounting bolts. The second possibility may be eliminated by using generous amounts of solder to bridge the earth lugs of the opposing power amplifier modules, and by soldering these lugs directly to the copper pattern.

POTENTIOMETER CURVE CODES: I have recently purchased some potentiometers and I would like to know what the letter after some values means. These include A, C, E and J. Perhaps there are others. I can only assume that they refer to a linear or logarithmic law. I would like to build a CRO from one of your previous publications. Which one would be best for general hobby work? Is there any chance that you will be describing a solid state CRO in the foreseeable future? Also, is there any chance that you could give an approximate cost for each project described? Congratulations on a fine magazine. (A.N., Kurralta Park), SA.

Firstly A.N., we are pleased to know that you like the magazine. There is no simple answer to your question on the coding of potentiometer curves. In some cases at least, A and C mean linear and logarithmic, respectively, but there are many more curves than those you have quoted and the letters used can mean different things, according to the system adopted by individual manufacturers. In the circumstances, the manufacturer should be consulted to ascertain the meaning of any particular code. The 1968 3in Audio Oscilloscope (File No 7/C/25) described in April, 1968, should be suitable for general hobby work. Although we hope to describe a solid state CRO in the reasonable future, we have no definite plans at present. The matter of giving cost estimates for our projects has been discussed at length in the past and we have found that there are many problems associated with the idea. In short, it is not a practical proposition and the best people to give prices are those who are offering components for sale.

SHORTWAVE NOTES: I am very disappointed with you for cutting out the shortwave notes by Arthur Cushen. It is one of the articles in your magazine that I always used to read. When I first bought the magazine it used to cost 6d and had more articles on all types of subjects, but over the years I have noticed that it is getting more on the technical side of things. One thing I would like to see is the prices with the advertisements. This can be done as the prices are usually the same in most states. Why isn't surplus equipment advertised as much as in American and English magazines? Finally, I don't know how my January issue got out of the factory — there wasn't a staple in it. (B.B., Sandringham, Vic.)

Otherwise, we're all right, eh? Seriously though, B.B., we have been forced to specialise in order to satisfy the needs of most of our readers. And inflation has inevitably had its effect on us, as it has on every other business and service. All we ask is that you compare us with the other publications in this and similar fields, and see if we don't offer pretty outstanding value for money. As for prices in advertisements, this is basically a matter for the advertisers themselves; similarly for the situation concerning surplus or disposals equipment. If you receive a faulty copy of the magazine, the best thing is to have it exchanged for a good one by your newsagent, who can claim from us. And finally, for the good news: as you have probably noticed by now, Arthur Cushen's column has been reinstated under the new heading "Shortwave Scene."

COLOUR TV DISPLAYS: I have been reading your magazine for three years, and find it excellent. I am particularly interested in video systems, especially colour TV displays such as the Trinitron. Why is it, though, that we haven't seen much lately on solid state displays and sensors, using ELSI circuitry? I have worked out a way of scanning a square array of photodiodes or light emitting diodes, using binary principles. The array consists of 1024 x 1024 elements, each with one connection to a vertical conductor and one to a horizontal conductor. I have worked out a system of LEDs and photoconductors for the scanning (details provided, but space prevents reproduction). Could you please comment? (G.E., Tuart Hill, WA.)

We published details of a solid-state TV camera by RCA using a bucket-brigade ELSI array, G.E., in the April 1973 issue. There hasn't been much information released on similar displays, although it would appear that many of the larger US and Japanese firms are well advanced in development of these. We realise the topic is one of wide interest, and will try to publish any information which is available.

Broadly speaking, all solid state imaging arrays developed to date use the digital scanning scheme. The exact method you have evolved to perform row and column switching is not clear from your letter, but our impression is that it is probably more complex than the usual systems. We doubt whether photoconductors would be fast enough as scanning switches, in any case. Finally, the size of your array does not seem to coincide with any existing system of TV standards. For the Australian system, for example, the appropriate array for a colour display would be something like 600 rows by 2,000 columns, assuming three colour elements for each approximately square array location.

TAPE ADAPTOR: There must be a great number of people with old valve tape recorders and surplus tape decks which, while mechanically sound, could do with a face lift in the electronics section to make them suitable for use with high class stereo amps. Have you any plans to publish a new state of the art tape adaptor? (L.McC., Oakleigh, Vic).

While you are probably correct that there are many old tape machines around, there does not seem to be much demand from our readers for new circuitry. At any rate, even if we did bring out a new tape adaptor design compatible with all the myriad decks produced in the past, they probably would not give reproduction of the same standard as the latest high quality decks. Apart from better tape, the main reason for improved reproduction from tape recorders is the great improvement in tape heads. We have no immediate plans to publish a new tape adaptor.

TAPE ACTUATED RELAY: Have you ever designed a circuit that can activate a relay from impulses on audio tape. The impulses on the tape would be made by an audio frequency oscillator. (R.H., Mordialloc, Vic.)

We have not published a circuit specifically intended for your application. However we did publish a circuit in September 1967 which triggered a relay using optically reflective sections stuck onto the tape. This was entitled "Tape Actuated Relay" (File No 2/MS/11). Alternatively, you could modify the circuit featured on page 55 of the December 1973 issue in the article entitled "Synchronisation of Taped Sound with Home

HOW TO USE OUR INFORMATION SERVICES

As a service to readers "Electronics Australia" is able to offer: (1) Project reprints, metal work dyelines, photographs, printed wiring patterns and other filed material to do with constructional projects and (2). A strictly limited degree of assistance by mail or through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: These cost 80c per issue-reprint. Thus, a project spread over three issues will cost $2.40. Reprints are available for all projects, but no material can be supplied additional to that already published. Reprints can be supplied more speedily if they are positively identified and not accompanied by technical queries. Material not on file can normally be supplied in photostat form at 40c per page.

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REPLIES BY POST: These are provided to assist readers encountering problems in the construction of our projects published within the last two years. Note, particularly, that we cannot provide lengthy answers, or undertake special research or modifications to basic designs. Charge: 80c. Inclusion of an additional fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee and may be answered in the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

COMMERCIAL EQUIPMENT: "Electronics Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals equipment etc. We are therefore not in a position to comment on any aspect of such equipment.

COMPONENTS: "Electronics Australia" does not deal in electronic components. Prices, specifications, etc should be sought from appropriate advertisers or agents.

REMITTANCES: These must be negotiable in Australia, and should be made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque, endorsed with a suitable limitation.

POSTAGE & PACKING: All charges shown include postage and packing, unless otherwise specified.

ADDRESS: All requests for data and information should be directed to the Assistant Editor, "Electronics Australia", Box 157, Beaconsfield 2014.

INFORMATION CENTRE

Movies" (File No 2/MS/30). Copies of both these articles are available from our information Service for the usual fee.

DEAD LETTER: We are holding a package addressed to Mr G. C. Charman, 5 Coon St, Gladstone, Queensland, 4680. This has been returned by the PMG's Department, marked, "Left Address." If Mr Charman will advise us of his new address, we will be happy to forward the material to him.

CASSETTE RECORDER: I would like to make a suggestion as to a possible future project, either as a "Playmaster" project or otherwise. Why not a cassette deck or even a complete recorder? I have almost finished the construction of such a unit, using the Vortex deck, a preamp offered by one of your advertisers, two power modules from the Playmaster 136, and a tone control from an overseas magazine. Performance is quite good, noise not being very prominent, for an outlay of only about $110. Any comments? (B.B., East Lavington, NSW).

We described a low-noise preamp for cassette decks in the November 1973 issue, and this can easily form the heart of a cassette playback deck. We hope to describe a complete recorder shortly. We agree that one can get quite good results for a modest outlay; just don't expect to compete with the top-of-the-line commercial recorders or decks.

Patch panel from p55

For the experimenter who must save every penny, just break apart some old noval valve sockets and use the bare pin connectors from these. Again a bit of heat shrinkable tubing permits one to get a grip on the connector and not the wire.

Although no power supply has been described for this unit, the "Simple Dual Power Supply for Op Amps" described by F. G. Canning in the January issue of "Electronics Australia" should prove satisfactory. Power supply components can be mounted inside the chassis used to support the patch panel.

That's it! Your patch panel can be as complete as possible, or as complete as you require it to be. It can use junkbox parts which have been assembled to the required precision, or off-the-shelf high precision components, or perhaps just components you have around which do the job. In any case the parts will stay put where you can find them, and will soon be known in value. They, like old friends, will be there when you need 'em, and can be relied on to be consistent if not perfect. Good op amping!

NOTES & ERRATA

CASSETTE PREAMPLIFIER (November 1973, 1/PRE/28): There are two errors in the parts list; 4 x 100 ohm resistors and 2 x 56pF capacitors are required instead of two and one respectively.

AC VOLTAGE REGULATOR (February 1972, File No 2/PC/17): In the parts list, delete the 47 ohm resistor and add one 15 ohm resistor.

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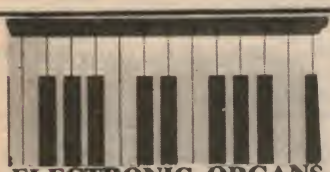

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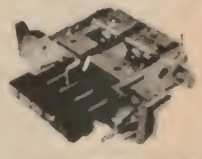

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MULTIMETER AND INSTRUMENT REPAIRS fast service to all makes, including AVO & Japanese types. We also sell a large range of new multimeters & electronic test equipment. Western Meter & Instrument Service, 31 Hazel Street, Girraween, N.S.W. Phone Sydney 631 2092.

PRINTED CIRCUIT DESIGNS. Using client's circuit diagrams we will design and create finished artwork to individual standards and specifications. Our design service includes: SINGLE and DOUBLE-SIDED ARTWORK, PLATED THROUGH HOLE ARTWORK, MAXIMUM or MINIMUM ETCH ARTWORK. Immediate quotations are given from circuit drawings or diagrams. LPC DESIGNS, PO Box 9403, Wellington, NEW ZEALAND.

WANTED

A&R TRANSFORMERS, power type 1783, output type 4014/15. As used in R&H 17 watt amp. J. Blythman, PO Box 6, Daw Pk, SA 5041.

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REPAIRS

To all quality Hi-Fi equipment, tape recorders and communications receivers.

All work guaranteed.

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SERVICE

CONVOY INTERNATIONAL OFFERS SERVICE ON ALL HI-FI EQUIPMENT AT SYDNEY'S LOWEST PRICES

FREE PARKING

Special tape recorder adjustment, our technicians can adjust your tape recorder so that it gives super performance on the brand of tape you use. You will be amazed at the improvement in performance for such a small charge.

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We have prepared all your wants. SALESIAN may now be what you are looking for!

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We can satisfy any items for your requirement.

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Ready to use & S.E.C. approved. Will vary speed from stop to full without loss of torque. Suitable for all ac/dc or brush type motors.
500 watt (2 amp.) size. *$14.90*
2500 watt (10 amp.) size. *$22.90*
Plus cert. post. Vic. 0.75. Other 1.15

BATTERY CHARGER BASIC KITS
Consist of transformer, bridge rectifier, ballast resistor, pair clips & circuit. Two amp. madel charges 12 volt batteries only. *$7.75*
Four amp. model charges both 6 & 12 volt batteries. *$14.95*
Plus pack & post. Vic. 0.65. Other 0.95

MOTOR SPEED CONTROLLER BASIC KIT
Consists of potentiometer, knob, triac, two diodes, w.w. resistor, 3 pin base, flex, plug & circuit. Controls speed of hand tools or other ac/dc brush type motors from full to stop. Will handle up to 500 watts. *$6.95* Includes pack & post.

LAMP DIMMER BASIC KIT
Consists of triac, diac, pot. w/switch, knob, ferrite rod inductor, 2 caps., 4 resistors & circuit. Will control incandescent lamps from full to out at up to 1400 watts. *$5.95.* Price includes postage.

PLASTIC CABINETS
Suitable for above Speed controller & Lamp dimmer kits. $1.35 Price includes postage.

BATTERY SAVER BASIC KITS
Consist of tapped transformer, bridge rectifier, filter capacitor & circuit. DC voltages from 6 to 15 available. Will replace batteries in radios, toys, rec. players, tape rec., etc.
One amp. size. *$6.95*
Two amp. size. *$8.95*
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BROADCAST BAND TUNER
Complete & ready to build into hi-fi amp. systems, tape rec., etc. Chassis size 6" x 4", with 8" aerial rod & straight line dial 6¾"x1¾". Output approx. ½ volt. Band width 8 khz. DC input 9 volts at 5 ma. *$23.95*
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STRAIGHT LINE DIAL
As used in above tuner. Glass, back plate, drum & hardware. *$5.95.*
Including postage.

SILICON DIODES
25 amp. stud mount type. Suitable for automotive or battery charger use. Both fwd. & rev. types avail. 50 P.I.V. rating *$1.25*
Heat sink adaptors to suit. 0.35
Prices include postage.

SELENIUM BRIDGE RECTIFIERS
Suitable battery chargers, etc. 6 amp. rating. 25 volt rms. max. *$4.95*
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SOUND PROJECTORS
Cinevox Prefect and Harmour and Heath 16mm in good working order. 240v operated, complete with speaker and amplifier.
from $115.00

CIRCULAR SLIDE RULE
3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included.
from $1.60 each
P & P 20c.

P.M.G. TYPE TELEPHONES
Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.
$25.00
(2 TELEPHONE SETS)
Including ¼ mile twin telephone cable $1 cartage to rail. Freight payable at nearest attended railway station.

WHIP AERIALS
3 Piece. Tapers from 1" to ⅛". No Base $4.95. Shop Sales Only.
66VTVM
University Graham Tested **$45** Post $1.00

MINIATURE ELECTRIC MOTORS
1½ to 3 volts DC. Ideal for model boats, cars, planes, etc. Strong torque. Only
65c each or 10 for $4
P & P 20c ea. or 10 for 55c.

AIRCRAFT CLOCKS
Genuine Smiths Eight Day Jewelled movement, sweep second hand and start of trip indicator. Dash mountings. Ideal for car rallys.
$17.50 P & P $1.05.

"PLESSEY"
Producermatic 2" professional endless cartridge replay machines 2 track stereo with third cue track for machine control (auto-stop etc.). 600 OHM line level outputs. 240V AC operation. All silicone transistors 7½ I.P.S. 19" rack mounting. 60 Hz (240V) Model $50, 50 Hz (240V) Model $60. Ideal for tape idents, background music, etc. $1 cartage to rail. Freight payable at nearest attended railway station.

TELEPHONE WIRE
1 mile twin (2 miles) genuine ex-Army Don 8 perfect condition $35 per drum $1 cartage to rail freight payable at destination.

PRISMATIC COMPASSES
Genuine ex-army Mk 3, liquid damped, as new **$27.50** P & P $1.05.

COLLINS TRANSCEIVERS
Auto-tuned 100-150MHz. 10 channels.
$65.00

HALF INCH RECORDING TAPE
Top Grade 2400' on 10½" reels. Ideal Video Experimenting. Only **$3.50**
P & P A. $1.55, B. $1.60, C. $1.95, D. $2.75. per reel.

UNI-SELECTORS
25 bank 25 position **$4** each.
P & P A. 70c, B. 85c, C. $1, D. $1.10.

ADLER FREQUENCY METER
100KHz-20MHz **$95**

4 DIGIT RELAY COUNTERS
50 volt DC, suit slot car. Lap counters, etc.
$1.25 each. P & P 30c.

NIBBLING TOOL
Cuts sheet metal like a punch and die, trims, notches and cuts to any size or shape over 7 16-inch.
ONLY **$6.50**
Post 55c

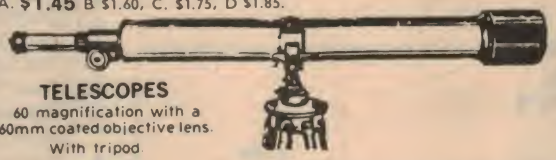
NIFE CELLS
1.2 Volt, fully charged, 4in x 3in x 1in 4 AH.
$1 each.
P & P 30c.

BC221
Frequency Meters.
$35.00

HANDY SIGNAL INJECTOR
Produces an Audio Signal in rich harmonics. Ideal for Sig Tracing in A.F., I.F., and R.F. circuits. Powered by 4 Penlight Batteries with On-Off Switch and indicator lamp. Size 1½" Diam. 5" Long. Only **$6.50** P&P 55c.

P.M.G TYPE KEY SWITCHES.
45c P & P 20c.

TELESCOPES ZOOM FOCUSING
25x 30 **$19.95** — 40 x 40 **$28.95**
P & P A. **$1.45** B $1.60, C. $1.75, D $1.85.



TELESCOPES
60 magnification with a 60mm coated objective lens.
With tripod
$29.50
As illustrated.
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2-way radio, 7 transistor, PMG approved, set of 2 only **$47.50**
9 transistor $59.50.
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SMALL COMPUTER PANELS
3in x 2in containing 2 valves, qty of resistors, etc.
ONLY **75c**
P & P 30c.

ELECTRONIC FREQUENCY COUNTER
Austronic type DFC-4 240V 50 cycle 0-100KHZ **$150**

IMPELLER PUMPS
New gunmetal body, Stainless Steel Shaft. Neoprene Impeller. Up to 15ft. Lift, suitable for almost any type of liquid. Self priming. Ideal boat bilge pump, sullage drains, etc. Approx size 8" x 5".

⅜"	$19.95
½"	$22.75
¾"	$27.50

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A.W.A. B.F.O. TYPE R7077
1-800 CYCLES
1-13 K/CS. **$30.00**

CONDENSER LENS
2½in DIAM. 2in FL. $1.50 each. Or $2.50 per pair. P & P 20c.

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100-150 M/CS
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Cossor Double Beam Oscilloscope 1035 Tested
$150

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BRAND NEW
IN CARTONS

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5U4G	95c	832	$5.00
EF50	75c	6AK5	$1.50
5Y3	$1.99	6X4	$1.00
2 x 2	75c	VR65	50c
6AG5	80c	VT4C	75c
		80	$1.25

P & P 30c.

PARABOLIC REFLECTORS PYREX MIRROR
36" dia. Ideal solar radio optical experimenting also decorating purposes. $37.50. Sorry shop sales only.

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X BAND WITH KLYSTRON ETC. **$45.00**

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100-165 M/CS **$25.00**

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Five sizes: ⅜-inch, ¾-inch, ⅞-inch, 1-inch and 1⅛-inches. With taper reamer.
$13.95
P & P A. $1.45, B. $1.60, C. $1.75, D. $1.85.

SELSYN MOTORS MAGSLIP Mk. II **$5.25 ea.**
No. 19 TWO-WAY RADIOS. Power supply, accessories, etc., $35.

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PRISMATIC. Coated Lenses. Brand new. Complete with case.

7 x 35 Wide Angle	$34.50
8 x 40 Wide Angle	$39.50
7 x 50	$28.65
10 x 50	$29.60
12 x 50	$30.60
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P & P A. $1.45, B. $1.60, C. $1.75, D. $1.85.

3000 TYPE RELAYS
P.M.G. 200 Ohms — 1,500 Ohm Coils. $1.25 each. P & P 30c.

TOGGLE SWITCHES
Brand new, 3 amp, 240 volt. S.P., S.T. 50c each or 10 for $4.
P & P 15c ea. or 10 for 55c.

Cintel Oscillator and Electronic Counter, type 388. **$250**

SPECIAL lucky dip valve offer, 15 new valves in cartons for only $2.95. We haven't got time to sort them, so you reap the benefit.
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CONDENSER LENS
1½in diam. 1½FL. 50c each
P & P 20c.

BATTERY CHARGERS BRAND NEW WITH METER
plugs into 240V power and gives both 6V and 12V DC output. 4 amps with hi, medium and low charges.
Dimensions, 9" x 5" x 5" $35 value only
$27.50
P & P A. $1.55, B. $1.60, C. $1.95, D. $2.75.

EX ABC RECORDING TAPES TOP BRANDS
¼" x 2400' ON 10½" REELS
$3.95
P & P A. 60c, B. 85c, C. $1, D. $1.10.

SOLENOIDS
Plunger Type 12V 300MA. Suit electric camera control, miniature trains, radio. etc.
$2.50 P & P 20c.
200 MA 24 volt, ½in push movement.
$2.50 P & P 20c.

ZOOM FOCUSING MICROSCOPE
Battery and mirror illuminated 900x magnification. Complete with dissecting kit slides etc.
P & P A. $1.45, B. $1.60, C. $1.75, D. $1.85. **$25.95**

TEN CHANNELS VHF TRANSCEIVER
Types TR 1934 100-125 MHz and TR 1935 125-150 MHz. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator
$33.00

RECORDING TAPES
TOP QUALITY, BRAND NEW

		Post
3" x 150'	.75c	15
3¼" x 600'	1.75	15
5" x 900'	2.20	15
5" x 1800'	3.99	20
7" x 1200'	3.25	20
7" x 2400'	5.80	55
7" x 3600'	6.99	55

CASSETTE TAPES
C60 **99c** C90 **$1.75** C120 **$1.95**
P & P 20c.

Crystal Earphone **75c** P & P 20c

Cassette head cleaners **$1.50** P & P 20c.

POCKET MULTIMETER
Volts A.C. and D.C. 15 to 1000 volts (3 Scales) Current D.C. 150 M.A. Resistance 1000 K Ohms Only **$8.95**
P&P 55c.

SMALL DYNAMIC MICROPHONES
On Stands Freq. Resp. 60-9500 Hz. Imp. 600-50 K Ohms. Size 1¼" x 2½" Only **$5.95** P&P 55c.

BYER 77 Mk. 1
Rack Mounting Tape Recorder ex A.B.C. 7½-15 ips. Full track tested
$150

Marconi Video Oscillator type TF885A 0.12 MHz $75.

A.W.A. SIG GENERATOR
UHF 140-300 MHz $65.00

TRANSPONDER APX6
with Lighthouse Tubes Can be converted to 1200 MHz **$17.**

Deitch Bros.
70 OXFORD STREET, SYDNEY 2010
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Box 157, Beaconsfield 2014.

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- Please insert the following advertisement in the ..... issue
- Tick the classification required

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Please write in block letters with ink or ball-point pen. **Number of insertions** .....

Signed: .....

Residential Address .....

..... State .....

- I enclose P. Note / Cheque for $..... being full payment for ..... lines at $1.00 per line. (minimum 2 lines)

Index to Advertisers

LEGALLY, WE CAN'T CALL THIS A REEL-TO-REEL DECK.

But reel-to-reel quality is what you'll enjoy from TEAC's new A-450 cassette deck.

We call it the "Challenger." And we challenge you to tell the difference between it and reel-to-reel.

We've perfected our new deck to the point of keeping wow and flutter below 0.07%.

We even improved what you can expect from the Dolby* Noise Reduction System.

Of course, we built the well-known Dolby into our A-450 to eliminate tape hiss and noise.

But we also put the system on the monitoring circuit. So you can copy Dolby cassette tapes and record FM Dolby broadcasts with de-coded monitoring.

Our best cassette deck deserves our best heads. Which is why you get wear-free High Density Ferrite Heads.

And to assure you of the smoothest possible tape travel, we designed a new tape drive mechanism.

Our A-450 is the only cassette deck we know of that even allows for full mic-line mixing capabilities.

Reel-to-reel supremacy has been challenged by the A-450.

Yet over the years, TEAC has continually developed a quality line of cassette decks.

Both our A-350 and A-250 feature the Dolby System. Because even on these decks, we knew that you should hear tapes only one way. Perfectly. They also feature those sophisticated Ferrite Heads.

The A-350 and A-250 are great. But our challenger is the A-450.

Remember. It's a cassette. But if you didn't see it, you'd swear you were listening to a reel-to-reel deck.

TEAC
The sound of perfection

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Why thoughtful people are smoking Hallmark

Hallmark aren't like conventional cigarettes. It's the filter system that makes them different.

There are two filters; one for smoothness, the other for mildness. So the smoke is more refined. But the good tobacco flavour still comes through.

Give some thought to Hallmark. They're worth thinking about.

Hallmark Dual Filter Worth thinking about

WH1015 E.A.F.P.